



## **STORMWATER MANAGEMENT REPORT**

**TURNERS FALLS MUNICIPAL AIRPORT  
ACADEMIC HANGAR  
TURNERS FALLS MA, 01376**

**Prepared: NOVEMBER 2023**

Town of Montague

**Prepared for:**

Turners Falls Municipal Airport  
1 Avenue A  
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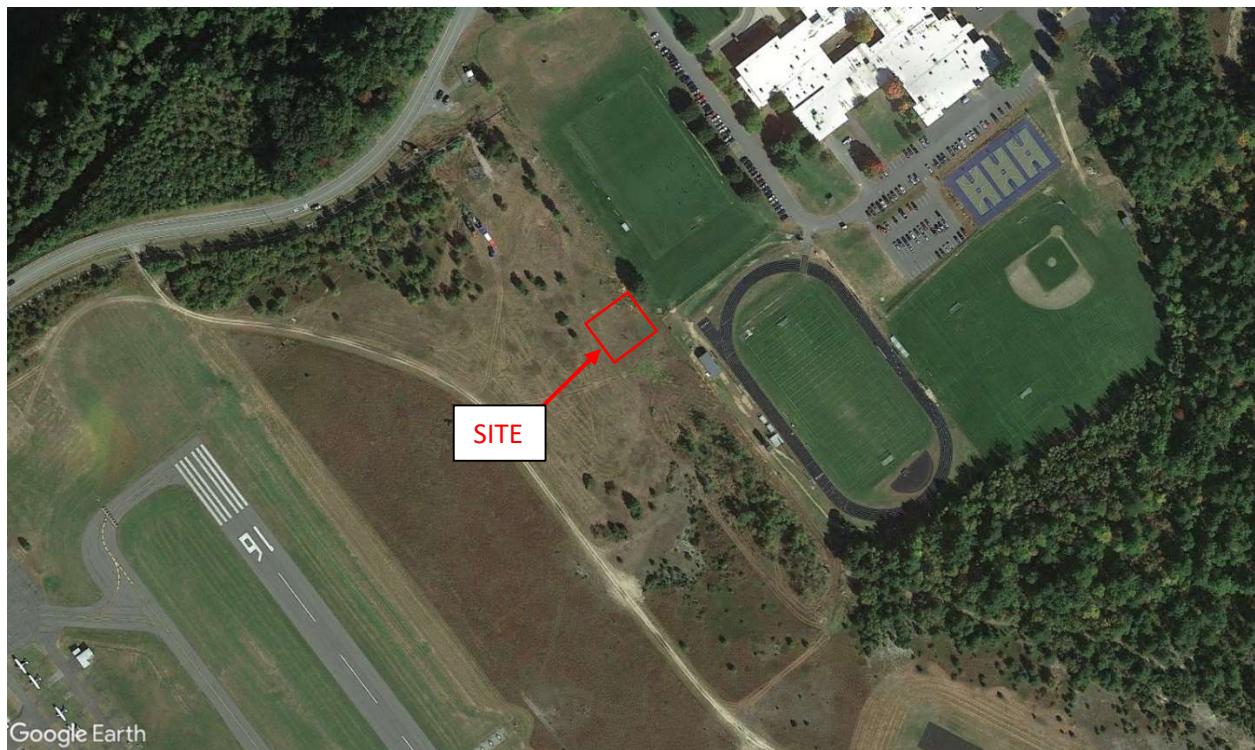


## **1.0 PROJECT DESCRIPTION**

Turners Falls Municipal Airport is proposing to construct an academic hangar for use of students of the abutting Franklin County Technical School. The proposed improvements include 12,000 sf hangar building, 5,400 sf aircraft apron, paved area for building access, and a bicycle rack. This report has been prepared in accordance with both the Massachusetts Stormwater Handbook and the Montague Planning Board Policies.

### **1.1 Existing Conditions**

Turners Falls Municipal Airport is located at 10 Aviation Way. The proposed project site is located along the northeast side of the airport and is currently an undeveloped grassy area. To the southwest of the project area is the existing airport runway. To the northeast of the project limits, on the Technical School's property, are an existing natural turf athletic field and an existing bituminous running track.



Locus Map

## **2.0 WETLANDS & ENVIRONMENTAL RESOURCE AREAS**

In accordance with the Massachusetts Stormwater Handbook and the Montague Planning Board Policies, a wetland and environmental resource area review was completed as part of preparing this stormwater management report. While the project area does not appear to be located within

a natural resource and/or associated buffer zone, the project site does appear to be located within priority habitat or rare species area as defined by the Natural Heritage & Endangered Species Program (NHESP). As a result, the project is expected to file a Massachusetts Endangered Species Act (MESA) review application with the Massachusetts Division of Fisheries and Wildlife (MassWildlife).

### **3.0 STORMWATER MANAGEMENT ANALYSIS**

To gain an understanding of the site hydrology in its current condition, Gale completed a site assessment. The following section describes the watershed analysis and current hydrologic condition of the site. Rainfall events were obtained from the Northeast Regional Climate Center (NRCC) Extreme Precipitation Database.

#### **3.1 Pre-Development Condition**

The project site and surrounding areas have been broken down into one (1) existing watershed that reflects the contributing areas of runoff to the design point. Existing topography was used to determine the watershed area. Refer to the Existing Watershed Map, located in Figure 9 of this report. The existing watershed area is described in more detail below.

##### **3.1.1 Pre-Development Watershed Analysis**

###### **Existing Watershed Area 1:**

The pre-development watershed area, Existing Watershed Area No. 1 (EWS-1), was delineated based on existing topographic contours. While the project area was previously disturbed to complete archaeological evaluation, field visits were performed to determine existing drainage runoff flow paths. Ultimately, stormwater runoff flows in a northerly direction towards the Franklin County Technical School. The Pre-development Watershed Map, located in Figure 9, illustrates the watershed boundaries, drainage flow paths, and design evaluation point (DP-1). Table 1, located below, summarizes the existing conditions watershed area.

**Table 1: Existing Watershed Area 1**

Sub-Watershed	EWS-1
Total Contributory Area (SF)	44,000
Curve Number (CN)	49
Time of Concentration (min)	12.5
Hydrologic Soil Group	A

### 3.2 Post-Development Condition

The Academic Hangar Project generally includes the following scope related to stormwater management:

- Installation of two infiltration drainage swales, one on the northwest side of the proposed hangar and other on the southeast side. The site is graded so that stormwater runoff from proposed improvements will flow into either of these swales, where it will infiltrate into the HSG Type A soil that composes the site.

#### 3.2.1 Post-Development Watershed Analysis

The post-development condition has been analyzed to determine the watershed areas and hydrology as they relate to the Design Point 1 (DP-1), which is consistent with the design point analysis completed for the pre-development condition. Please see the Post-Development Watershed Map, located in Figure 11.

##### Post-Development Watershed Area 1:

Post-Development Watershed Area No. 1 (PWS-1) encompasses the north and westerly portions of the project limits, including the west half of the proposed academic hangar roof and aircraft apron. Stormwater runoff from PWS-1 will flow westerly and be collected into the proposed into an infiltration drainage swale. Table 2 summarizes the PWS-1 conditions.

**Table 2: Post-Development Watershed Area 1**

<b>Sub-Watershed</b>	<b>PWS-1</b>
Total Contributory Area (SF)	24,440
Curve Number (CN)	69
Time of Concentration (min)	5.4
Hydrologic Soil Group	A

##### Post-Development Watershed Area 2:

Post-Development Watershed Area No. 2 (PWS-2) encompasses the south and easterly portions of the project limits, including the east half of the proposed academic hangar roof and aircraft apron. Stormwater runoff from PWS-2 will flow easterly and be collected into the proposed into an infiltration drainage swale. Table 3 summarizes the PWS-2 conditions.

**Table 3: Post-Development Watershed Area 2**

<b>Sub-Watershed</b>	<b>PWS-2</b>
Total Contributory Area (SF)	19,560
Curve Number (CN)	78
Time of Concentration (min)	5.3
Hydrologic Soil Group	A

#### **4.0 COMPLIANCE WITH STORMWATER STANDARDS**

##### **4.1 Untreated Stormwater (Standard 1)**

The project is designed so that stormwater conveyances (outfalls/discharges) do not discharge untreated stormwater into or cause erosion to downstream properties, to the maximum extent practicable, by providing two infiltration drainage swales, which detains stormwater runoff for infiltration. These BMPs will reduce the runoff into the Town's drainage system and mitigate erosion.

##### **4.2 Post-Development Peak Rates (Standard 2)**

Pre- and post-development stormwater runoff analyses were performed and compared for the 2-, 10-, 25-, and 100-year, 24-hour storm events. Based on the pre- and post-development comparison, it was determined that the proposed project and its Stormwater Management System would not increase the peak runoff rates above existing levels. It is the intent of the Stormwater Management System to minimize impacts to drainage patterns, downstream property, and wetlands, while simultaneously providing water quality treatment to runoff prior to its release from the site or its discharge to wetlands.

The U.S.D.A. Soil Conservation Service (SCS) Technical Release 55 (TR-55), 1986, was used as the procedure for estimating runoff. A HydroCAD SCS TR-20-based computer program was used for estimating peak discharges. TR-55 is a generally accepted model for use on small sites and begins with a rainfall amount uniformly imposed on the watershed over a specified time distribution. Mass rainfall is converted to mass runoff by using a runoff curve number (CN). The CN is based on soils, plant cover, impervious areas, interception, and surface storage. Runoff is then transformed into a hydrograph that depends on runoff travel time through segments of the watershed.

Stormwater management computations for the full-build were performed using SCS-based HydroCAD, as well as for existing and proposed conditions curve numbers, times of concentrations, and unit hydrograph computations.

**Table 4: Peak Rate Comparison**

Analysis Point	Design Storm	Existing Runoff (CFS)	Proposed Runoff (CFS)
DP-1	2-yr	0.01	0.00
	10-yr	0.16	0.00
	25-yr	0.44	0.00
	100-yr	1.36	0.00

#### 4.3 Recharge to Groundwater (Standard 3)

The project controls the stormwater runoff from the site by attenuating and treating the runoff using the infiltration drainage swales, recharging the groundwater.

Required Recharge Volume for the site was calculated in accordance with the Standard 3:

$R_v$  = Required Recharge Volume

$F$  = Target Depth Factor (0.6 inches for soils of Hydrologic Soil A)

$I$  = New Impervious Area (building roof, paved area), measured in acres

$$I = 21,462 \text{ SF} = 0.493 \text{ Ac}$$

$$\begin{aligned}
 R_v &= F * I \\
 R_v &= R_{v_w} + R_{v_e} \\
 &= \left( \frac{.6}{12} * 10,012 \text{ ft}^2 \right) + \left( \frac{.6}{12} * 11,450 \text{ ft}^2 \right) \\
 &= \left( \frac{.6}{12} * .230 \text{ Ac} \right) + \left( \frac{.6}{12} * .263 \text{ Ac} \right) \\
 &= .0115 \text{ Ac} - \text{ft} + .01315 \text{ Ac} - \text{ft} = 501 \text{ ft}^3 + 573 \text{ ft}^3 \\
 &= \frac{0.6}{12} * 0.493 = 0.02465 \text{ Ac} - \text{ft} = 1074 \text{ ft}^3
 \end{aligned}$$

From the above equation, 1,074  $\text{ft}^3$  are needed to meet the  $Re_v$  requirements for this project site. The requirement will be met by using the storage volume of the infiltration drainage swales to store and infiltrate stormwater to the maximum extent practicable

$$\begin{aligned}
 Re_{v\text{PROVIDED}} &= (\text{storage volume of } W \text{ swale}) + (\text{storage volume of } E \text{ swale}) \\
 &= (9,262 \text{ ft}^3) + (8,231 \text{ ft}^3) = 17,493 \text{ ft}^3
 \end{aligned}$$

The approximately 17,493  $\text{ft}^3$  of storage available in the infiltration drainage swales exceeds the 1,074  $\text{ft}^3$  required for  $Re_v$ .

$$A_w = \frac{R_{v_w}}{D_w + K * T}$$

$$A_w = \frac{501 \text{ ft}^3}{1.75 \text{ ft} + 0.201 \text{ ft/hr} * 2 \text{ h}} = 233 \text{ ft}^2$$

$$A_e = \frac{R_{v_e}}{D_e + K * T}$$

$$A_e = \frac{573 \text{ ft}^3}{2.75 \text{ ft} + 0.201 \text{ ft/hr} * 2 \text{ h}} = 182 \text{ ft}^2$$

$A$  = Minimum Required Surface Area of the Bottom of the Infiltration Structure

$R_{v_w}$  = Required Recharge Volume of West Swale =  $501 \text{ ft}^3$

$D_w$  = Depth of the Infiltration Facility (West Swale) =  $1.75 \text{ ft}$

$R_{v_e}$  = Required Recharge Volume of East Swale =  $501 \text{ ft}^3$

$D_e$  = Depth of the Infiltration Facility (East Swale) =  $2.75 \text{ ft}$

$K$  = Saturated Hydraulic Conductivity =  $2.41 \text{ in/h} = 0.201 \text{ ft/hr}$

$T$  = Allowable Drawdown During the Peak of the Storm =  $2 \text{ hr}$

The required surface area of the bottom of the west swale is  $233 \text{ ft}^2$  and the proposed surface area is  $3,371 \text{ ft}^2$ , which exceeds the requirement. The required surface area of the bottom of the east swale is  $182 \text{ ft}^2$  and the proposed surface area is  $1,128 \text{ ft}^2$ , which exceeds the requirement.

The drawdown time from the infiltration drainage swales for the required recharge volume is calculated as follows:

$$Time_{drawdown_w} = \frac{R_{v_w}}{(K) * (Bottom Area_w)}$$

$$= \frac{9,262 \text{ ft}^3}{(0.201 \text{ ft/hr}) * (3,371 \text{ ft}^2)}$$

$$= 13.67 \text{ hours}$$

$$Time_{drawdown_e} = \frac{R_{v_e}}{(K) * (Bottom Area_w)}$$

$$= \frac{8,231 \text{ ft}^3}{(0.201 \text{ ft/hr}) * (1,128 \text{ ft}^2)}$$

$$= 38.30 \text{ hours}$$

$R_v$  = Storage Volume ( $\text{ft}^3$ )

$K$  = Saturated Hydraulic Conductivity ( $\text{ft/hr}$ )

$Bottom Area$  = Effective Bottom Area of Recharge Structure ( $\text{ft}^2$ )

The drawdown time for the infiltration west infiltration swale is 13.67 *hr* and for the east infiltration swale it is 38.30 *hr*, both of which are below the required drawdown time of 72 hours.

#### 4.4 Water Quality (Standard 4)

Stormwater runoff generated from the proposed academic hangar and new paved area associated with the hangar will be collected into infiltration drainage swales. The following equation is used to calculate  $V_{WQ}$ :

$$V_{WQ} = \frac{(D_{WQ})(A_{IMP} * 43,560 \text{ ft}^2/\text{Ac})}{12} = \frac{(1'')(21,462 \text{ ft}^2)}{12} = 1,789 \text{ ft}^3$$

Where:

- $V_{WQ}$  = water quality volume required ( $\text{ft}^3$ )
- $D_{WQ}$  = water quality depth = 1"
- $A_{IMP}$  = post-development impervious area (acres)

Meeting the  $V_{WQ}$  requirement will be accomplished through the infiltration drainage swales on either side of the hangar.

$$\begin{aligned} V_{WQ\text{PROVIDED}} &= (\text{storage volume of W swale}) + (\text{storage volume of E swale}) \\ &= (9,262 \text{ ft}^3) + (8,231 \text{ ft}^3) = 17,493 \text{ ft}^3 \end{aligned}$$

As calculated in the above equation, the approximately 17,493  $\text{ft}^3$  of volume available in the infiltration drainage swales exceeds the 1,789  $\text{ft}^3$  required for  $V_{WQ}$ .

The 80% TSS removal requirement will be met through the infiltration drainage swales, which will be maintained and perform as infiltration basins. The MassDEP TSS removal calculation spreadsheet is included in Figure 5

#### 4.5 Land Uses with Higher Potential Pollutant Loads (Standard 5)

The project is not a LUHPPL.

#### 4.6 Critical Areas (Standard 6)

The site does not lie within a critical area and is not listed in the Massachusetts Department of Environmental Protection's Areas of Critical environmental Concern List (MassDEP ACEC), Latest Edition (see Figure 2).

#### 4.7 Redevelopment (Standard 7)

This project, as designed, meets the stormwater standards for new construction.

#### **4.8 Erosion and Sedimentation Controls (Standard 8)**

An Erosion and Sedimentation Control Plan is provided as part of the plan set submitted as part of the stormwater management report to the Town. The project will be covered by a National Pollutant Discharge Elimination System (NPDES) Construction General Permit and Stormwater Pollution Prevention Plan (SWPPP). The contractor will provide these items prior to the start of construction.

#### **4.9 Operation and Maintenance Plan (Standard 9)**

An Operation and Maintenance Plan is provided as part of the stormwater management report submitted to the Town. See Appendix D for the Operation and Maintenance Plan.

#### **4.10 Prohibition of Illicit Discharges (Standard 10)**

There are no illicit discharges to the proposed Stormwater Management System. A template for an illicit discharge compliance statement has been provided as part of the stormwater management report submitted to the Town. A completed statement will be submitted prior to the discharge of stormwater to the post-construction Stormwater Management System. Refer to Appendix D.

### **5.0 SUMMARY**

The Academic Hangar Project is intended to improve new educational opportunities for the students of the Franklin County Technical School and to improve the Turners Falls Municipal Airport. The project takes the opportunity to provide water quality and peak flow improvements within the watersheds, providing peak runoff control and water quality improvements.

The project, as proposed, is the “best fit” for this site, and an improvement to the adjacent areas. The project proves to be a betterment to the environment by exceeding all the standards set forth in the Massachusetts Stormwater Handbook.



## **APPENDIX A: GENERAL INFORMATION**



## Project Locus Map

TURNERS FALLS MUNICIPAL AIRPORT  
ACADEMIC HANGAR  
TURNERS FALLS, MA



Reference: USGS TopoQuad – Greenfield Quadrangle

Figure 1



# Project Environmental Resource Areas

## TURNERS FALLS MUNICIPAL AIRPORT ACADEMIC HANGAR TURNERS FALLS, MA



Reference: MassMapper GIS Viewer



### NHESP Data

-  NHESP Priority Habitat of Rare Species
-  NHESP Estimated Habitat of Rare Wildlife
-  Certified Vernal Pool
-  Potential Vernal Pool
-  Area of Critical Environmental Concern (ACEC)

### Wetlands

-  Marsh/Bog
-  Wooded Marsh
-  Cranberry Bog
-  Salt Marsh
-  Open Water
-  Reservoir w/PWSID
-  Tidal Flats
-  Beach/Dune

### Regulated Areas

-  Zone II Well Area
-  IWPA

### Outstanding Resource

#### Waters (ORW)




-  ORW for ACEC
-  PWS Contributor
-  ORW for PWS and Other

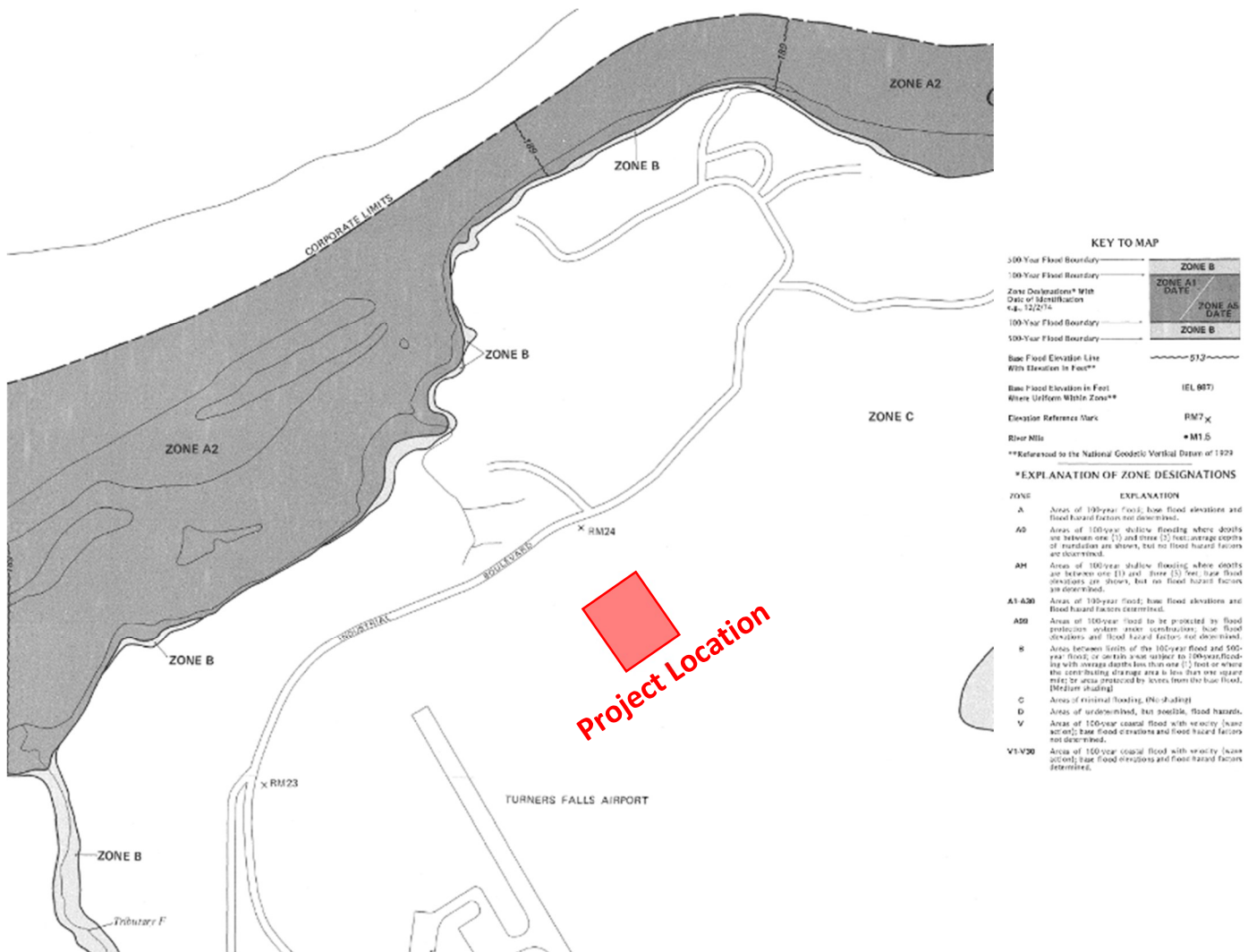
Figure 2





# Flood Hazard Zones

## TURNERS FALLS MUNICIPAL AIRPORT ACADEMIC HANGAR TURNERS FALLS, MA



Reference: FEMA National Flood Hazard Layer (NFHL) Viewer

Figure 3







Figure 4





MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
Web Soil Survey URL:  
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Franklin County, Massachusetts  
Survey Area Data: Version 18, Sep 12, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Oct 15, 2020—Oct 31, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	19.4	6.8%
131B	Yalesville-Holyoke complex, 3 to 8 percent slopes, rocky	0.0	0.0%
229F	Windsor and Merrimac soils, 25 to 60 percent slopes	20.5	7.2%
254A	Merrimac fine sandy loam, 0 to 3 percent slopes	11.9	4.2%
255A	Windsor loamy sand, 0 to 3 percent slopes	34.9	12.2%
255B	Windsor loamy sand, 3 to 8 percent slopes	60.1	21.0%
255C	Windsor loamy sand, 8 to 15 percent slopes	11.2	3.9%
656	Udorthents-Urban land complex	127.8	44.7%
<b>Totals for Area of Interest</b>		<b>285.9</b>	<b>100.0%</b>

INSTRUCTIONS:

- 1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
- 2. Select BMP from Drop Down Menu
- 3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location:

Turners Falls Educational Hangar

B

C

D

E

F

BMP<sup>1</sup>

TSS Removal  
Rate<sup>1</sup>

Starting TSS  
Load\*

Amount  
Removed (C\*D)

Remaining  
Load (D-E)

Infiltration Basin	0.80	1.00	0.80	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20
	0.00	0.20	0.00	0.20

TSS Removal  
Calculation Worksheet

Total TSS Removal =

Separate Form Needs to  
be Completed for Each  
Outlet or BMP Train

80%

Project:

719300

Prepared By:

CRR

Date:

11/6/2023

\*Equals remaining load from previous BMP (E)  
which enters the BMP

Non-automated TSS Calculation Sheet  
must be used if Proprietary BMP Proposed  
1. From MassDEP Stormwater Handbook Vol. 1

Figure 5

# Extreme Precipitation Tables

## Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Metadata for Point	
Smoothing State	No
Location	
Latitude	42.591 degrees North
Longitude	72.524 degrees West
Elevation	100 feet
Date/Time	Wed Nov 08 2023 09:17:32 GMT-0500 (Eastern Standard Time)

### Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.29	0.44	0.54	0.73	0.89	1.06	1yr	0.77	1.04	1.19	1.52	1.97	2.47	2.73	1yr	2.18	2.63	3.04	3.68	4.29	1yr
2yr	0.34	0.53	0.65	0.89	1.09	1.27	2yr	0.94	1.24	1.44	1.85	2.35	2.95	3.29	2yr	2.61	3.17	3.66	4.37	5.00	2yr
5yr	0.41	0.63	0.79	1.08	1.37	1.58	5yr	1.18	1.54	1.78	2.27	2.85	3.64	4.14	5yr	3.22	3.98	4.61	5.37	6.12	5yr
10yr	0.47	0.73	0.90	1.26	1.63	1.87	10yr	1.40	1.83	2.09	2.65	3.29	4.26	4.93	10yr	3.77	4.74	5.49	6.29	7.14	10yr
25yr	0.57	0.87	1.09	1.55	2.04	2.33	25yr	1.76	2.28	2.58	3.27	3.99	5.25	6.21	25yr	4.65	5.97	6.92	7.74	8.75	25yr
50yr	0.66	1.01	1.26	1.81	2.43	2.75	50yr	2.10	2.69	3.04	3.83	4.62	6.16	7.40	50yr	5.45	7.12	8.25	9.06	10.20	50yr
100yr	0.77	1.17	1.46	2.11	2.90	3.26	100yr	2.50	3.18	3.58	4.49	5.36	7.23	8.83	100yr	6.40	8.49	9.84	10.61	11.91	100yr
200yr	0.90	1.35	1.71	2.47	3.45	3.86	200yr	2.98	3.77	4.22	5.27	6.21	8.49	10.54	200yr	7.51	10.14	11.75	12.44	13.91	200yr
500yr	1.10	1.64	2.11	3.06	4.35	4.82	500yr	3.76	4.71	5.24	6.51	7.55	10.50	13.33	500yr	9.29	12.82	14.86	15.35	17.07	500yr

### Lower Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.23	0.35	0.43	0.58	0.72	0.84	1yr	0.62	0.82	0.97	1.32	1.61	2.26	2.37	1yr	2.00	2.28	2.69	3.41	3.93	1yr
2yr	0.33	0.51	0.63	0.85	1.05	1.22	2yr	0.91	1.20	1.39	1.78	2.28	2.88	3.20	2yr	2.55	3.08	3.56	4.26	4.88	2yr
5yr	0.37	0.57	0.71	0.98	1.24	1.44	5yr	1.07	1.41	1.62	2.09	2.62	3.41	3.88	5yr	3.02	3.73	4.30	5.06	5.74	5yr
10yr	0.41	0.63	0.78	1.09	1.41	1.59	10yr	1.21	1.56	1.83	2.34	2.92	3.88	4.47	10yr	3.43	4.30	4.96	5.76	6.48	10yr
25yr	0.46	0.70	0.88	1.25	1.65	1.81	25yr	1.42	1.77	2.15	2.69	3.34	4.62	5.42	25yr	4.09	5.21	6.00	6.84	7.63	25yr
50yr	0.51	0.77	0.96	1.38	1.86	1.99	50yr	1.61	1.95	2.43	2.98	3.70	5.27	6.29	50yr	4.67	6.05	6.96	7.81	8.62	50yr
100yr	0.56	0.85	1.06	1.53	2.10	2.19	100yr	1.82	2.14	2.77	3.31	4.10	6.03	7.30	100yr	5.34	7.02	8.08	8.93	9.75	100yr
200yr	0.62	0.93	1.18	1.71	2.38	2.39	200yr	2.06	2.34	3.14	3.66	4.54	6.92	8.47	200yr	6.12	8.14	9.40	10.21	11.03	200yr
500yr	0.72	1.07	1.37	1.99	2.83	2.69	500yr	2.44	2.63	3.74	4.20	5.19	8.30	10.37	500yr	7.35	9.97	11.51	12.23	13.05	500yr

### Upper Confidence Limits

	5min	10min	15min	30min	60min	120min		1hr	2hr	3hr	6hr	12hr	24hr	48hr		1day	2day	4day	7day	10day	
1yr	0.32	0.50	0.61	0.82	1.00	1.18	1yr	0.87	1.15	1.33	1.70	2.14	2.62	2.93	1yr	2.32	2.82	3.20	3.89	4.53	1yr
2yr	0.36	0.56	0.69	0.93	1.15	1.35	2yr	0.99	1.32	1.49	1.95	2.44	3.04	3.40	2yr	2.69	3.27	3.79	4.49	5.15	2yr
5yr	0.45	0.70	0.87	1.19	1.51	1.71	5yr	1.31	1.67	1.94	2.45	3.06	3.91	4.41	5yr	3.46	4.24	4.96	5.70	6.49	5yr
10yr	0.55	0.84	1.04	1.45	1.88	2.08	10yr	1.62	2.04	2.37	2.96	3.66	4.72	5.40	10yr	4.17	5.19	6.08	6.84	7.77	10yr
25yr	0.70	1.06	1.32	1.88	2.48	2.71	25yr	2.14	2.65	3.09	3.83	4.64	6.06	7.05	25yr	5.36	6.78	7.96	8.72	9.83	25yr
50yr	0.84	1.28	1.59	2.29	3.08	3.30	50yr	2.66	3.23	3.77	4.64	5.56	7.29	8.64	50yr	6.45	8.31	9.77	10.46	11.75	50yr
100yr	1.02	1.54	1.93	2.79	3.83	4.04	100yr	3.31	3.95	4.61	5.65	6.65	8.80	10.58	100yr	7.79	10.17	11.98	12.55	14.05	100yr
200yr	1.24	1.86	2.36	3.41	4.76	4.94	200yr	4.11	4.83	5.62	6.88	7.96	10.63	12.95	200yr	9.40	12.45	14.68	15.06	16.80	200yr
500yr	1.60	2.38	3.07	4.46	6.34	6.46	500yr	5.47	6.31	7.33	8.93	10.11	13.60	16.93	500yr	12.04	16.28	19.18	19.16	21.28	500yr

## 1982 Rawls Rates

**TURNERS FALLS MUNICIPAL AIRPORT  
ACADEMIC HANGAR  
TURNERS FALLS, MA**

<b>Texture Class</b>	<b>NRCS Hydrologic Soil Group (HSG)</b>	<b>Infiltration Rate Inches/Hour</b>
Sand	A	8.27
Loamy Sand	A	2.41
Sandy Loam	B	1.02
Loam	B	0.52
Silt Loam	C	0.27
Sandy Clay Loam	C	0.17
Clay Loam	D	0.09
Silty Clay Loam	D	0.06
Sandy Clay	D	0.05
Silty Clay	D	0.04
Clay	D	0.02

Reference: MassDEP Stormwater Handbook Volume 3: Documenting Compliance with the Massachusetts Stormwater Management Standards, Table 2.3.3

Figure 7

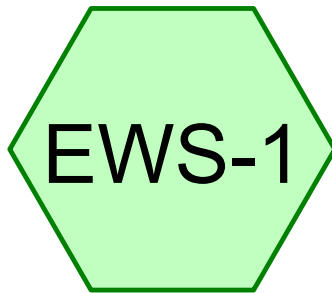




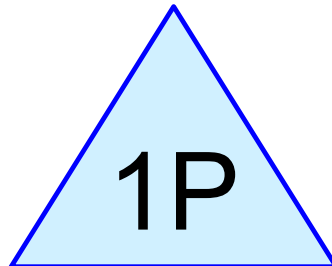
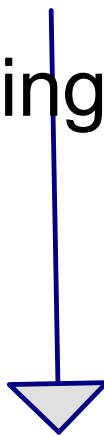


**APPENDIX B: PRE-DEVELOPMENT ANALYSIS  
2, 10, 25, AND 100-YEAR STORM EVENTS**

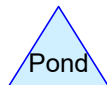
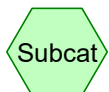




Existing Site



Offsite Runoff



**Routing Diagram for 719300 PRE**

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**719300 PRE**

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Page 2

**Rainfall Events Listing (selected events)**

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	2.95	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.25	2
3	25-yr	Type III 24-hr		Default	24.00	1	5.23	2
4	100-yr	Type III 24-hr		Default	24.00	1	7.18	2

## 719300 PRE

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Page 3

### Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
44,000	49	50-75% Grass cover, Fair, HSG A (EWS-1)
<b>44,000</b>	<b>49</b>	<b>TOTAL AREA</b>

**719300 PRE**

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Page 4

**Soil Listing (all nodes)**

Area (sq-ft)	Soil Group	Subcatchment Numbers
44,000	HSG A	EWS-1
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
<b>44,000</b>		<b>TOTAL AREA</b>

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
44,000	0	0	0	0	44,000	50-75% Grass cover, Fair	EWS-1
44,000	0	0	0	0	44,000	TOTAL AREA	

**719300 PRE**

*Type III 24-hr 2-yr Rainfall=2.95"*

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Page 6

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EWS-1: Existing Site**

Runoff Area=44,000 sf 0.00% Impervious Runoff Depth>0.05"

Flow Length=290' Slope=0.0065 '/' Tc=12.5 min CN=49 Runoff=0.01 cfs 178 cf

**Pond 1P: Offsite Runoff**

Inflow=0.01 cfs 178 cf

Primary=0.01 cfs 178 cf

**Total Runoff Area = 44,000 sf Runoff Volume = 178 cf Average Runoff Depth = 0.05"**  
**100.00% Pervious = 44,000 sf 0.00% Impervious = 0 sf**



**Summary for Subcatchment EWS-1: Existing Site**

Runoff = 0.01 cfs @ 14.91 hrs, Volume= 178 cf, Depth> 0.05"  
 Routed to Pond 1P : Offsite Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-yr Rainfall=2.95"

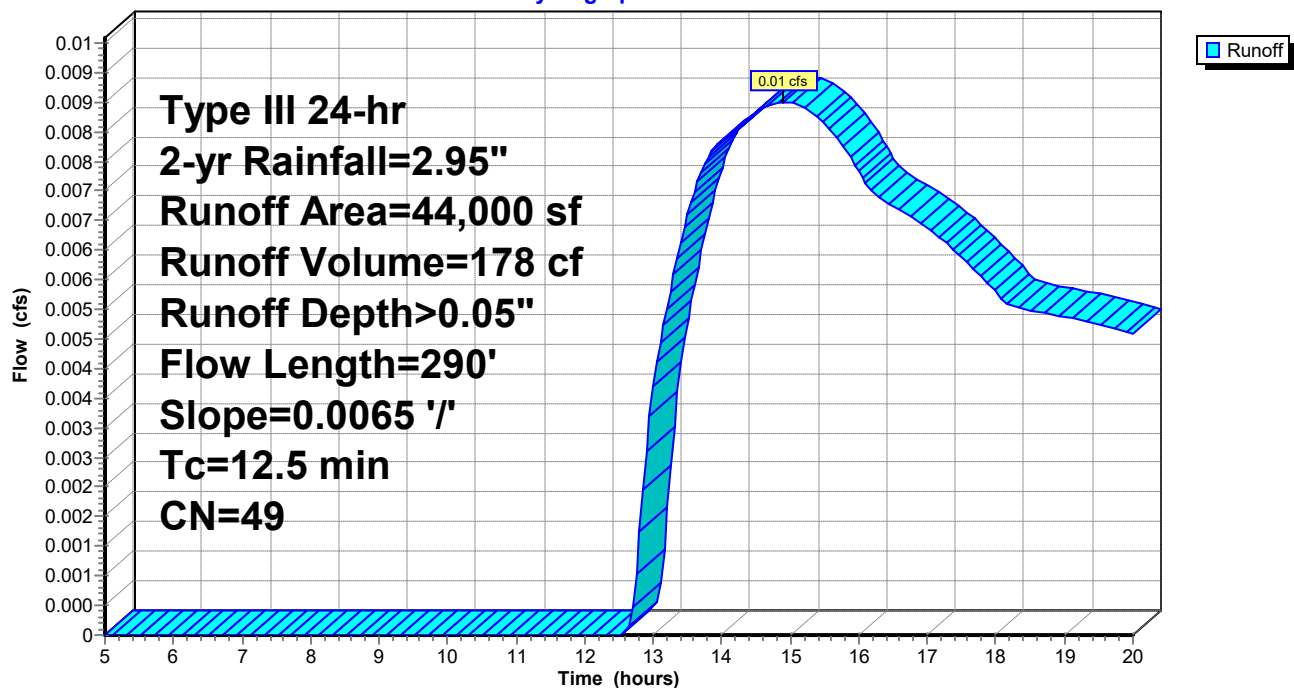
Area (sf)	CN	Description
44,000	49	50-75% Grass cover, Fair, HSG A
44,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0065	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
3.3	240	0.0065	1.21		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
12.5	290	Total			

**Subcatchment EWS-1: Existing Site**

Hydrograph



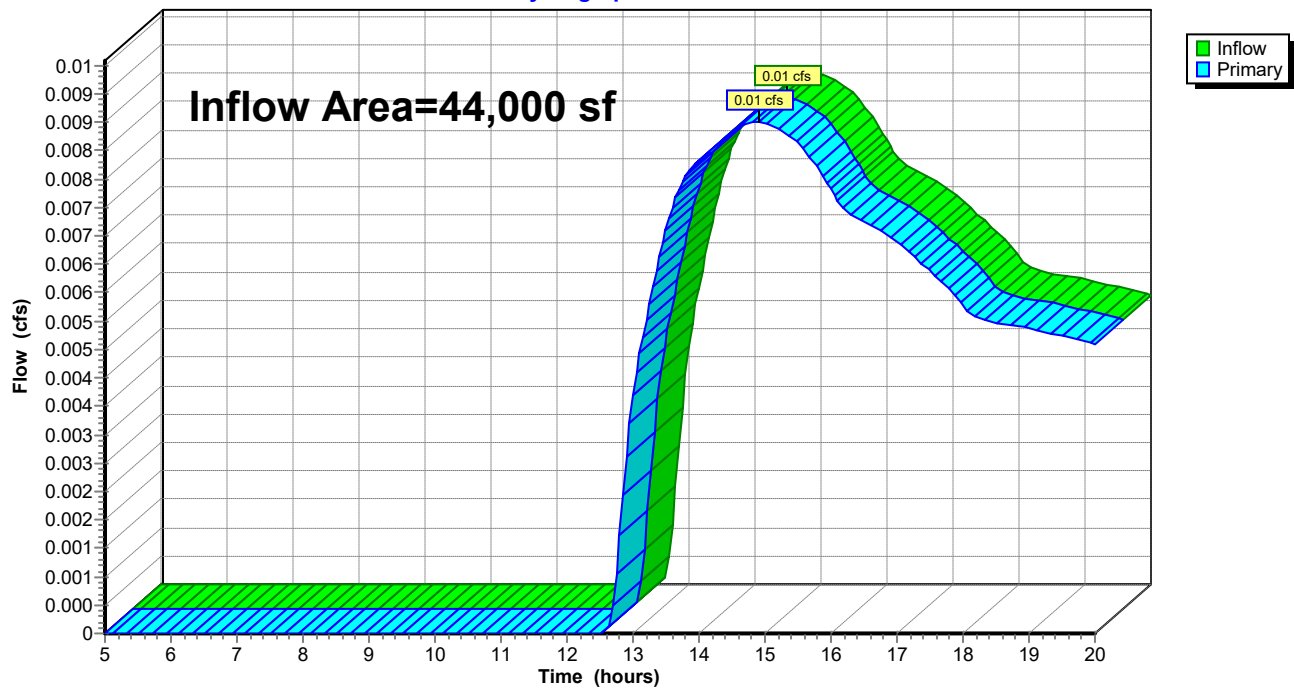
**Summary for Pond 1P: Offsite Runoff**

Inflow Area = 44,000 sf, 0.00% Impervious, Inflow Depth > 0.05" for 2-yr event  
Inflow = 0.01 cfs @ 14.91 hrs, Volume= 178 cf  
Primary = 0.01 cfs @ 14.91 hrs, Volume= 178 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Pond 1P: Offsite Runoff**

Hydrograph



**719300 PRE***Type III 24-hr 10-yr Rainfall=4.25"*

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Page 9

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EWS-1: Existing Site**

Runoff Area=44,000 sf 0.00% Impervious Runoff Depth>0.32"  
Flow Length=290' Slope=0.0065 '/' Tc=12.5 min CN=49 Runoff=0.16 cfs 1,156 cf

**Pond 1P: Offsite Runoff**

Inflow=0.16 cfs 1,156 cf  
Primary=0.16 cfs 1,156 cf

**Total Runoff Area = 44,000 sf Runoff Volume = 1,156 cf Average Runoff Depth = 0.32"**  
**100.00% Pervious = 44,000 sf 0.00% Impervious = 0 sf**

**Summary for Subcatchment EWS-1: Existing Site**

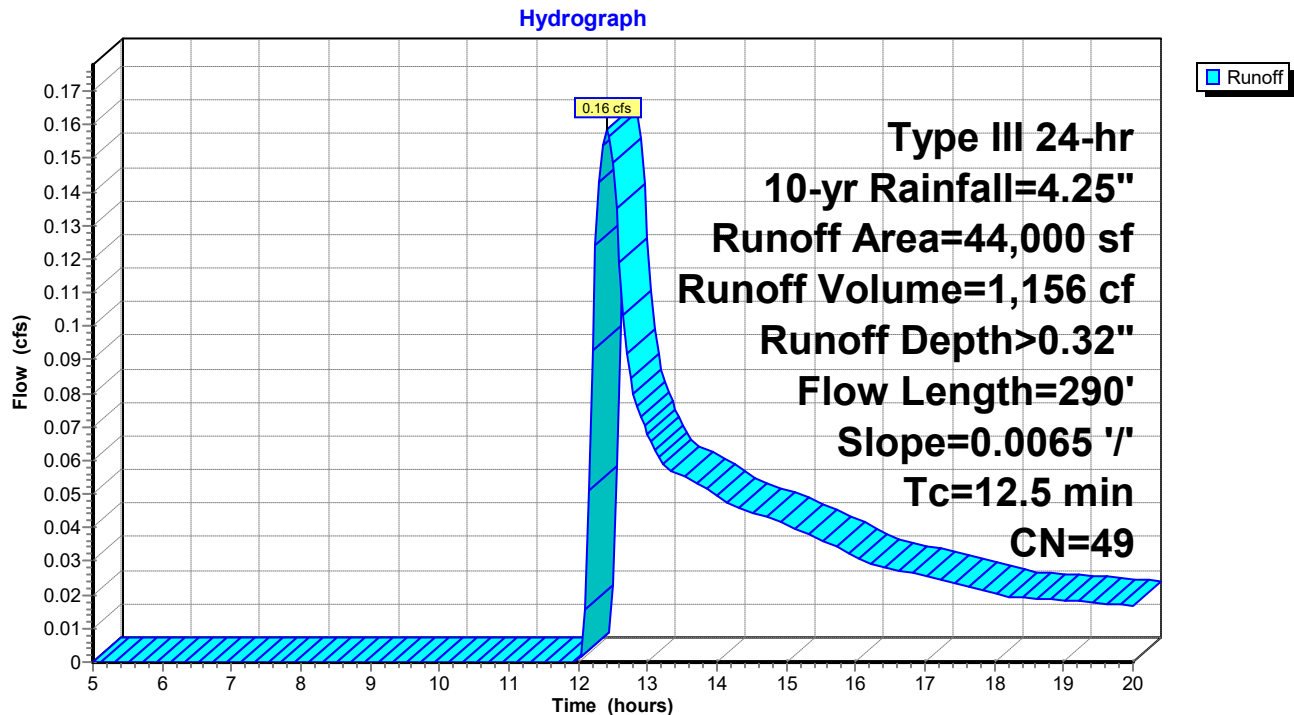
Runoff = 0.16 cfs @ 12.41 hrs, Volume= 1,156 cf, Depth> 0.32"  
 Routed to Pond 1P : Offsite Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
44,000	49	50-75% Grass cover, Fair, HSG A
44,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0065	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
3.3	240	0.0065	1.21		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
12.5	290	Total			

**Subcatchment EWS-1: Existing Site**

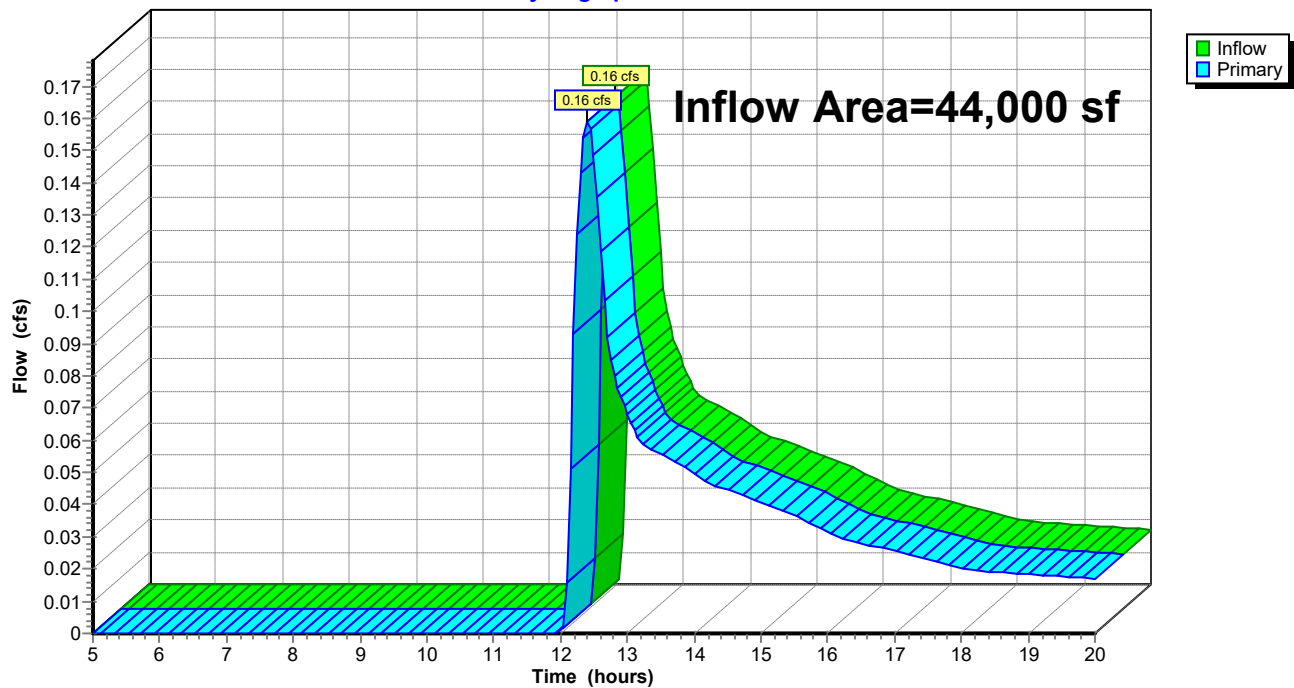
**Summary for Pond 1P: Offsite Runoff**

Inflow Area = 44,000 sf, 0.00% Impervious, Inflow Depth > 0.32" for 10-yr event  
Inflow = 0.16 cfs @ 12.41 hrs, Volume= 1,156 cf  
Primary = 0.16 cfs @ 12.41 hrs, Volume= 1,156 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Pond 1P: Offsite Runoff**

Hydrograph



**719300 PRE***Type III 24-hr 25-yr Rainfall=5.23"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EWS-1: Existing Site**

Runoff Area=44,000 sf 0.00% Impervious Runoff Depth>0.64"  
Flow Length=290' Slope=0.0065 '/' Tc=12.5 min CN=49 Runoff=0.44 cfs 2,334 cf

**Pond 1P: Offsite Runoff**

Inflow=0.44 cfs 2,334 cf  
Primary=0.44 cfs 2,334 cf

**Total Runoff Area = 44,000 sf Runoff Volume = 2,334 cf Average Runoff Depth = 0.64"**  
**100.00% Pervious = 44,000 sf 0.00% Impervious = 0 sf**

**Summary for Subcatchment EWS-1: Existing Site**

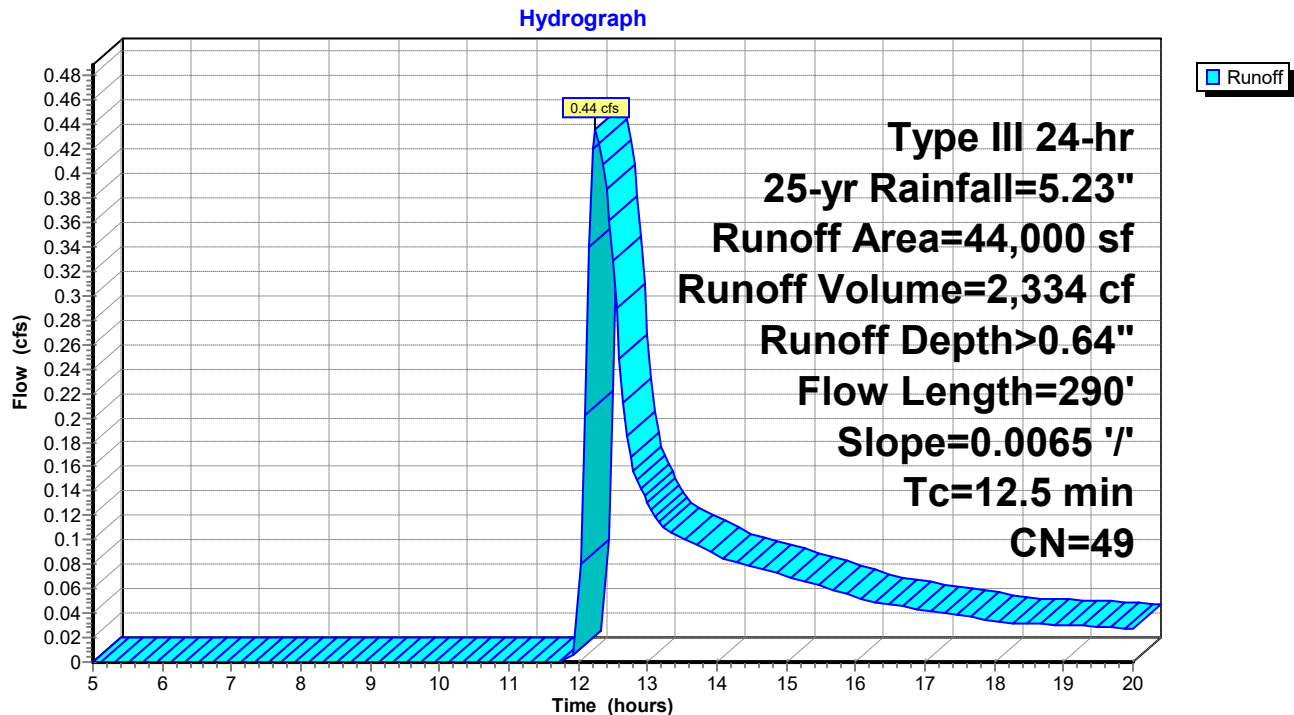
Runoff = 0.44 cfs @ 12.25 hrs, Volume= 2,334 cf, Depth> 0.64"  
 Routed to Pond 1P : Offsite Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-yr Rainfall=5.23"

Area (sf)	CN	Description
44,000	49	50-75% Grass cover, Fair, HSG A
44,000		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0065	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
3.3	240	0.0065	1.21		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
12.5	290	Total			

**Subcatchment EWS-1: Existing Site**

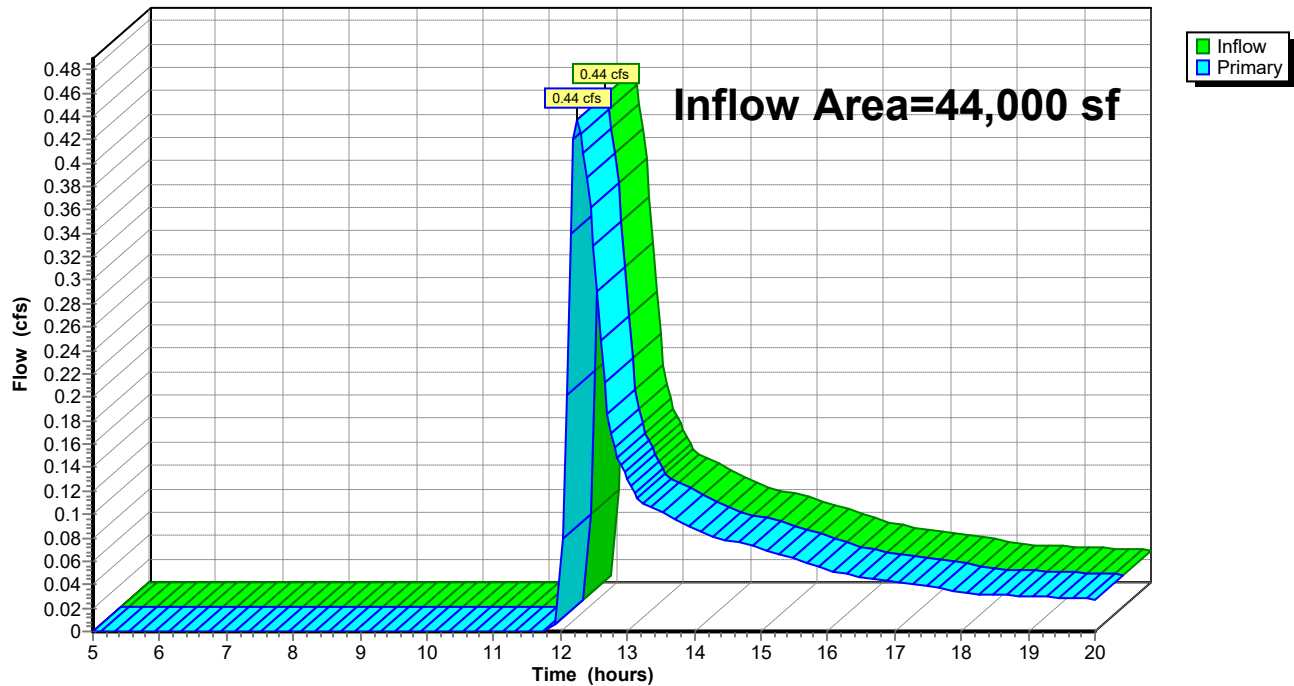
**Summary for Pond 1P: Offsite Runoff**

Inflow Area = 44,000 sf, 0.00% Impervious, Inflow Depth > 0.64" for 25-yr event  
Inflow = 0.44 cfs @ 12.25 hrs, Volume= 2,334 cf  
Primary = 0.44 cfs @ 12.25 hrs, Volume= 2,334 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Pond 1P: Offsite Runoff**

Hydrograph





**719300 PRE**

*Type III 24-hr 100-yr Rainfall=7.18"*

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Page 15

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EWS-1: Existing Site**

Runoff Area=44,000 sf 0.00% Impervious Runoff Depth>1.50"  
Flow Length=290' Slope=0.0065 '/' Tc=12.5 min CN=49 Runoff=1.36 cfs 5,504 cf

**Pond 1P: Offsite Runoff**

Inflow=1.36 cfs 5,504 cf  
Primary=1.36 cfs 5,504 cf

**Total Runoff Area = 44,000 sf Runoff Volume = 5,504 cf Average Runoff Depth = 1.50"**  
**100.00% Pervious = 44,000 sf 0.00% Impervious = 0 sf**

**Summary for Subcatchment EWS-1: Existing Site**

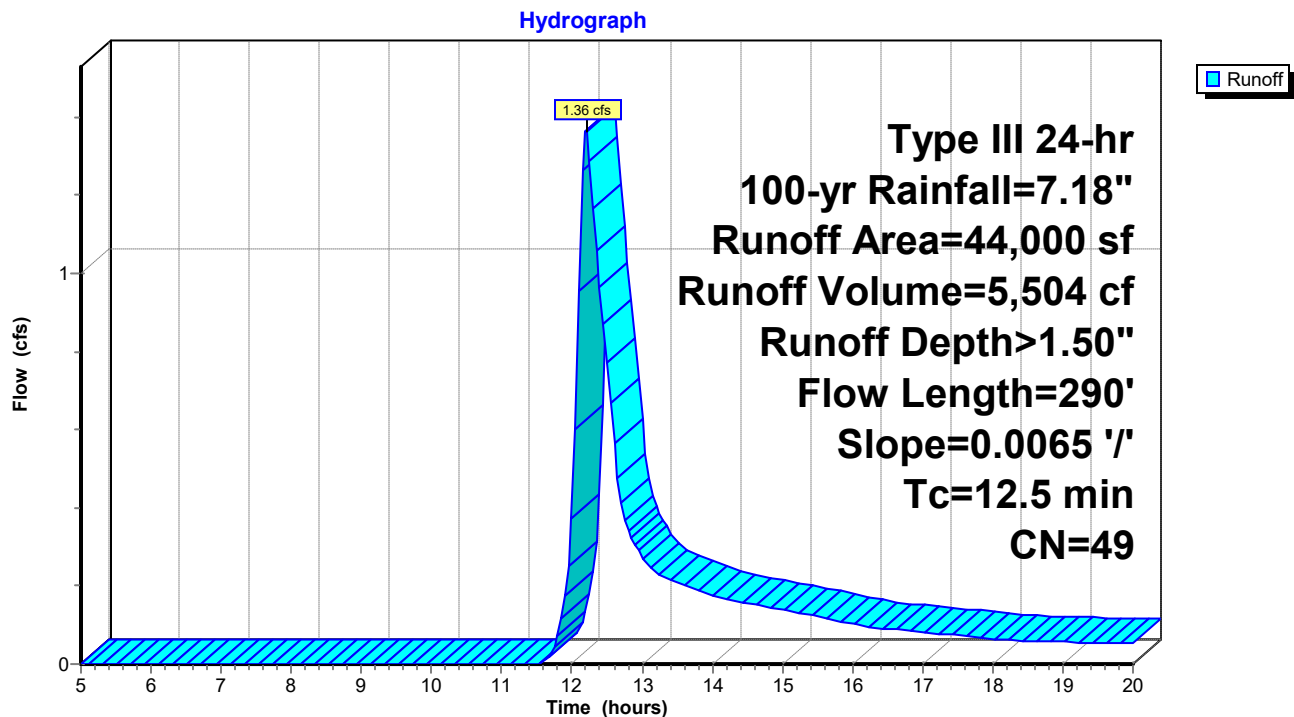
Runoff = 1.36 cfs @ 12.20 hrs, Volume= 5,504 cf, Depth> 1.50"  
 Routed to Pond 1P : Offsite Runoff

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-yr Rainfall=7.18"

Area (sf)	CN	Description
44,000	49	50-75% Grass cover, Fair, HSG A
44,000		100.00% Pervious Area

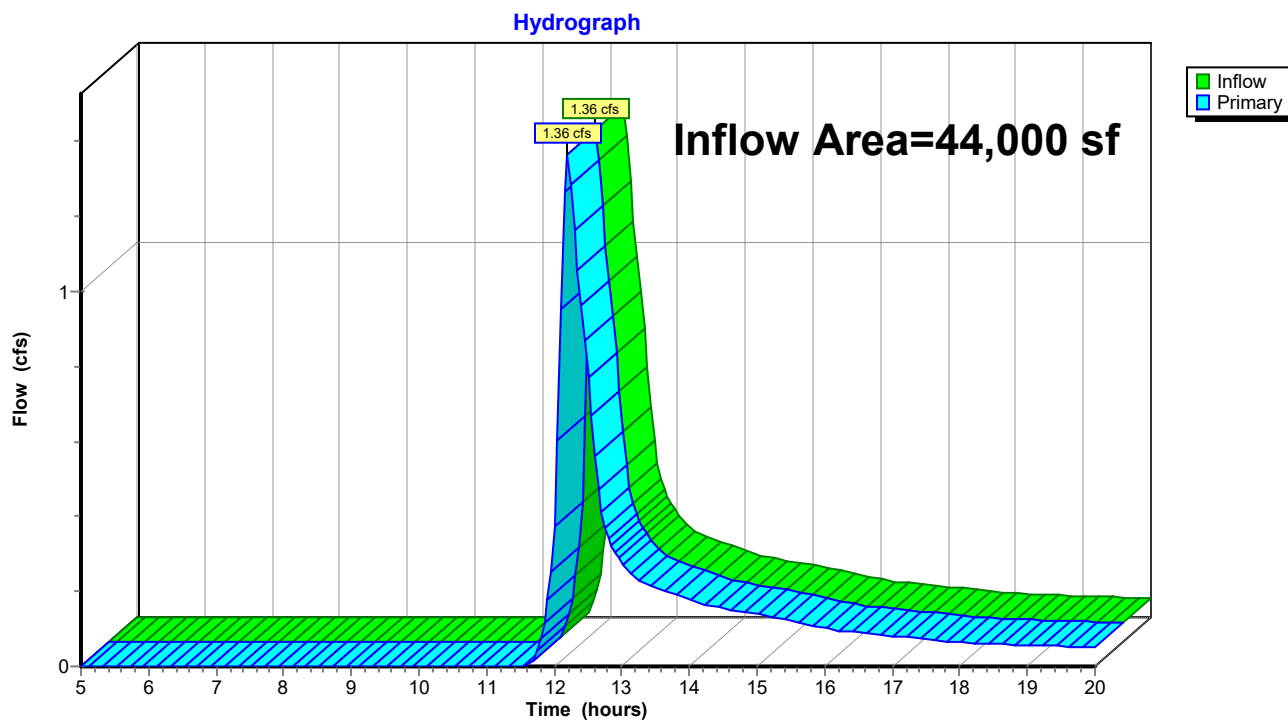
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.2	50	0.0065	0.09		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
3.3	240	0.0065	1.21		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
12.5	290	Total			

**Subcatchment EWS-1: Existing Site**

**Summary for Pond 1P: Offsite Runoff**

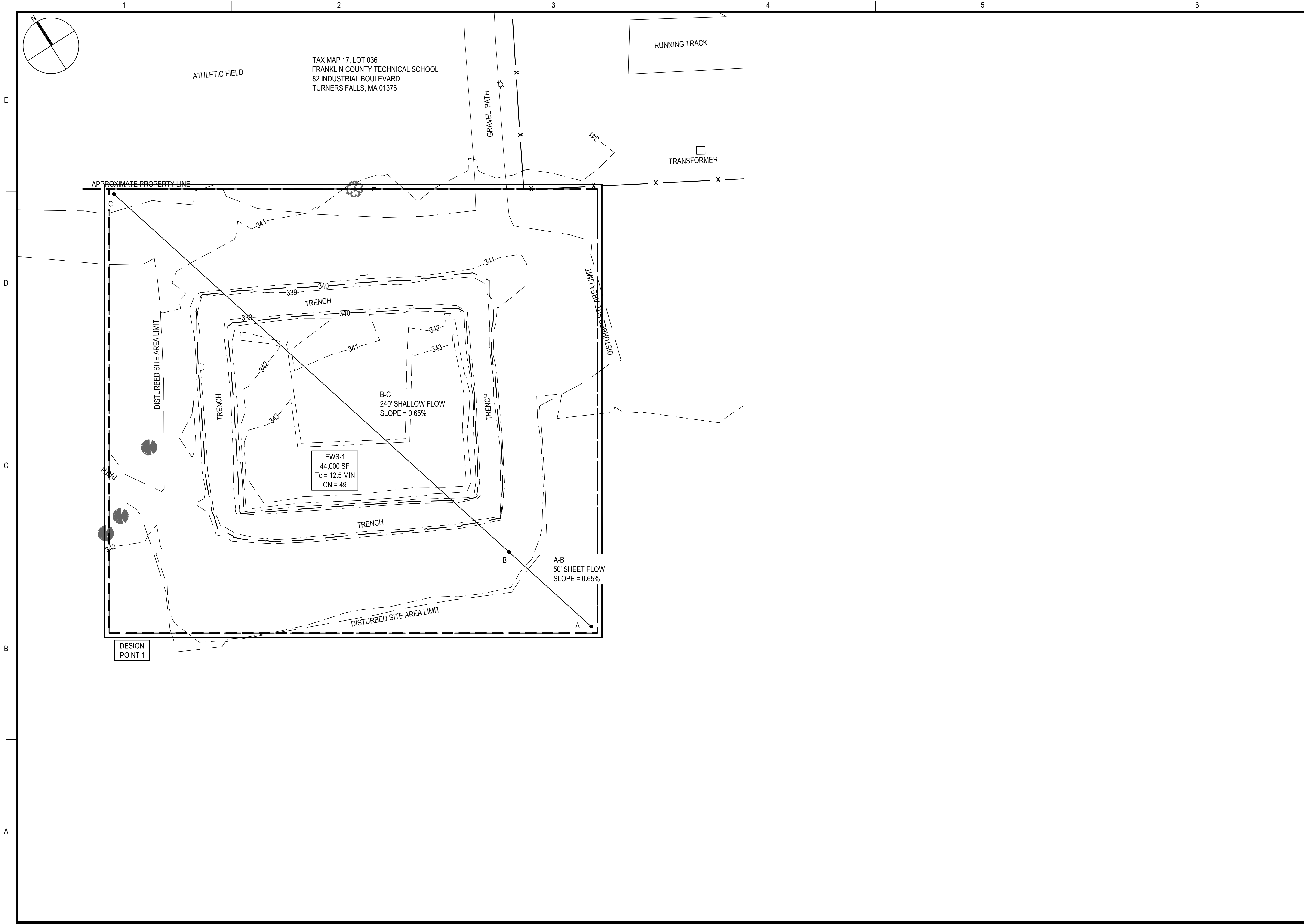
Inflow Area = 44,000 sf, 0.00% Impervious, Inflow Depth > 1.50" for 100-yr event  
Inflow = 1.36 cfs @ 12.20 hrs, Volume= 5,504 cf  
Primary = 1.36 cfs @ 12.20 hrs, Volume= 5,504 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

**Pond 1P: Offsite Runoff**



F:\719300\plots\0 - Site Plan - Final\719300\_PRE.dwg, 11/8/2023 9:45:51 AM, DWG To PDF.pc3





**Gale Associates, Inc.**  
Engineers and Planners

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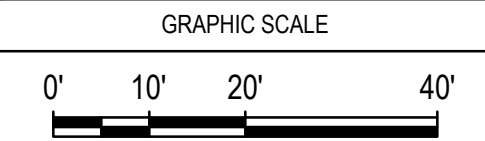
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PERMIT SET

NOT FOR CONSTRUCTION

PROJECT	ACADEMIC HANGAR TURNERS FALLS MUNICIPAL AIRPORT		OWNER	TURNERS FALLS MUNICIPAL AIRPORT 1 AVENUE A TURNERS FALLS, MASSACHUSETTS 01376	

NO.	DATE	DESCRIPTION	BY
PROJECT NO.	719300		
CADD FILE	719300_PRE		
DESIGNED BY	CRR/SMB		
DRAWN BY	CRR		
CHECKED BY	SMB		
DATE	11/10/23		
DRAWING SCALE	1" = 20'		



SHEET TITLE

PRE  
DEVELOPMENTAL  
WATERSHED MAP

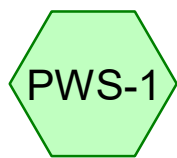
	FIGURE NO.
	9
	1 OF 1



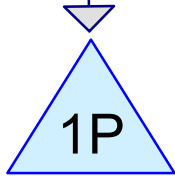
**APPENDIX C: POST-DEVELOPMENT ANALYSIS  
2, 10, 25, AND 100-YEAR STORM EVENTS**



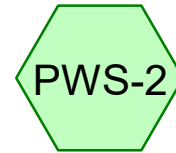




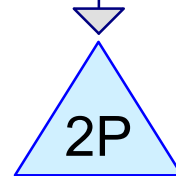
W



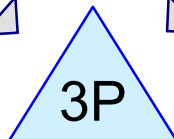
Swale W



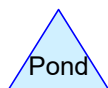
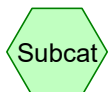
E



Swale E



Offsite Runoff



**Routing Diagram for 719300 POST**

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## 719300 POST

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Page 2

### Rainfall Events Listing (selected events)

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	2-yr	Type III 24-hr		Default	24.00	1	2.95	2
2	10-yr	Type III 24-hr		Default	24.00	1	4.25	2
3	25-yr	Type III 24-hr		Default	24.00	1	5.23	2
4	100-yr	Type III 24-hr		Default	24.00	1	7.18	2

## 719300 POST

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Page 3

### Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
22,538	49	50-75% Grass cover, Fair, HSG A (PWS-1, PWS-2)
9,462	98	Unconnected pavement, HSG A (PWS-1, PWS-2)
12,000	98	Unconnected roofs, HSG A (PWS-1, PWS-2)
<b>44,000</b>	<b>73</b>	<b>TOTAL AREA</b>

## 719300 POST

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### Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
44,000	HSG A	PWS-1, PWS-2
0	HSG B	
0	HSG C	
0	HSG D	
0	Other	
<b>44,000</b>		<b>TOTAL AREA</b>

Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Subcatchment Numbers
22,538	0	0	0	0	22,538	50-75% Grass cover, Fair	PWS-1, PWS-2
9,462	0	0	0	0	9,462	Unconnected pavement	PWS-1, PWS-2
12,000	0	0	0	0	12,000	Unconnected roofs	PWS-1, PWS-2
44,000	0	0	0	0	44,000	TOTAL AREA	

**719300 POST***Type III 24-hr 2-yr Rainfall=2.95"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment PWS-1: W**

Runoff Area=24,440 sf 40.97% Impervious Runoff Depth>0.58"  
Flow Length=242' Tc=5.4 min CN=69 Runoff=0.36 cfs 1,173 cf

**Subcatchment PWS-2: E**

Runoff Area=19,560 sf 58.54% Impervious Runoff Depth>1.00"  
Flow Length=303' Tc=5.3 min CN=78 Runoff=0.56 cfs 1,635 cf

**Pond 1P: Swale W**

Peak Elev=338.29' Storage=140 cf Inflow=0.36 cfs 1,173 cf  
Outflow=0.19 cfs 1,168 cf

**Pond 2P: Swale E**

Peak Elev=338.65' Storage=552 cf Inflow=0.56 cfs 1,635 cf  
Outflow=0.09 cfs 1,629 cf

**Pond 3P: Offsite Runoff**

**Total Runoff Area = 44,000 sf Runoff Volume = 2,808 cf Average Runoff Depth = 0.77"**  
**51.22% Pervious = 22,538 sf 48.78% Impervious = 21,462 sf**

**Summary for Subcatchment PWS-1: W**

Runoff = 0.36 cfs @ 12.10 hrs, Volume= 1,173 cf, Depth> 0.58"  
 Routed to Pond 1P : Swale W

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-yr Rainfall=2.95"

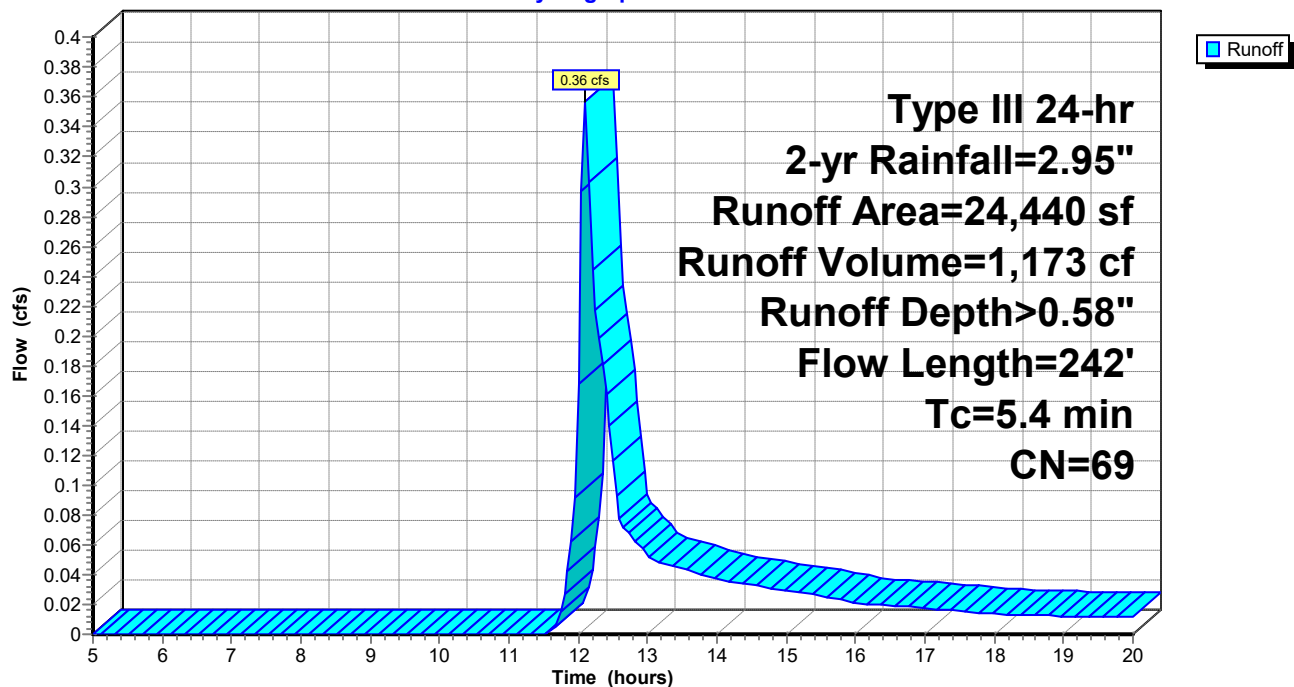
Area (sf)	CN	Description
14,428	49	50-75% Grass cover, Fair, HSG A
4,012	98	Unconnected pavement, HSG A
6,000	98	Unconnected roofs, HSG A
24,440	69	Weighted Average
14,428		59.03% Pervious Area
10,012		40.97% Impervious Area
10,012		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	21	0.0150	0.86		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.95"
2.0	29	0.1044	0.25		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
3.0	192	0.0050	1.06		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
5.4	242	Total			

**Subcatchment PWS-1: W**

Hydrograph



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Type III 24-hr 2-yr Rainfall=2.95"

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**Summary for Subcatchment PWS-2: E**

Runoff = 0.56 cfs @ 12.09 hrs, Volume= 1,635 cf, Depth> 1.00"  
 Routed to Pond 2P : Swale E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 2-yr Rainfall=2.95"

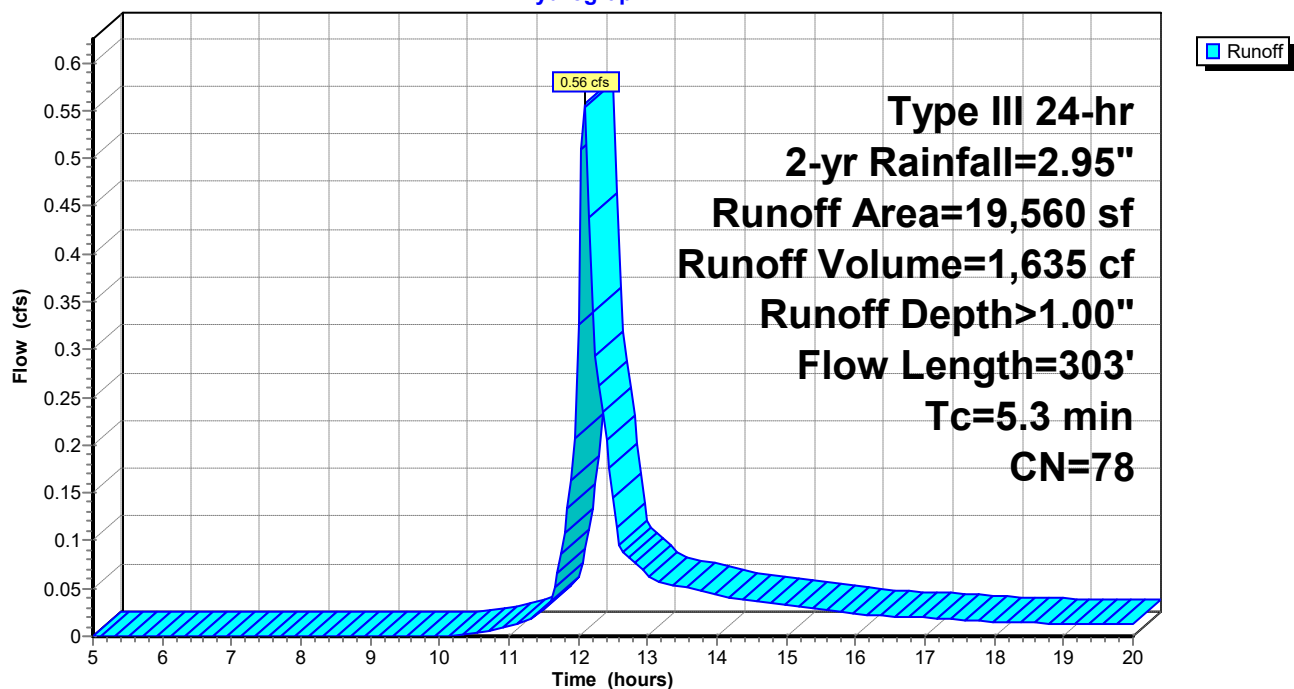
Area (sf)	CN	Description
6,000	98	Unconnected roofs, HSG A
8,110	49	50-75% Grass cover, Fair, HSG A
5,450	98	Unconnected pavement, HSG A
19,560	78	Weighted Average
8,110		41.46% Pervious Area
11,450		58.54% Impervious Area
11,450		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	38	0.0150	0.97		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.95"
2.7	12	0.0083	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
1.9	253	0.0220	2.22		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
5.3	303	Total			

**Subcatchment PWS-2: E**

Hydrograph





**Summary for Pond 1P: Swale W**

Inflow Area = 24,440 sf, 40.97% Impervious, Inflow Depth > 0.58" for 2-yr event  
 Inflow = 0.36 cfs @ 12.10 hrs, Volume= 1,173 cf  
 Outflow = 0.19 cfs @ 12.32 hrs, Volume= 1,168 cf, Atten= 46%, Lag= 12.9 min  
 Discarded = 0.19 cfs @ 12.32 hrs, Volume= 1,168 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 338.29' @ 12.32 hrs Surf.Area= 3,458 sf Storage= 140 cf  
 Flood Elev= 341.00' Surf.Area= 7,121 sf Storage= 9,262 cf

Plug-Flow detention time= 8.9 min calculated for 1,168 cf (100% of inflow)  
 Center-of-Mass det. time= 7.2 min ( 842.7 - 835.5 )

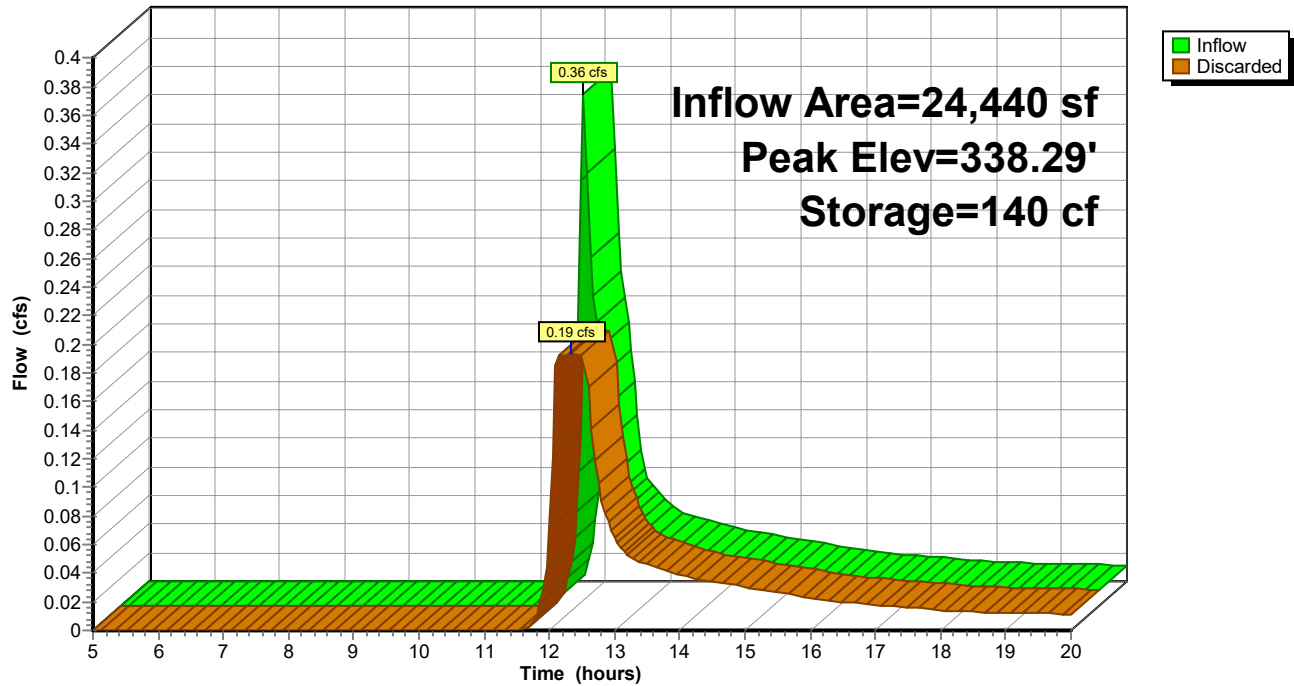
Volume	Invert	Avail.Storage	Storage Description
#1	338.25'	9,262 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
338.25	3,371	560.0	0	0	3,371
339.00	5,129	602.0	3,165	3,165	7,279
340.00	7,121	666.0	6,098	9,262	13,768

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.25'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.19 cfs @ 12.32 hrs HW=338.29' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.19 cfs)

**Pond 1P: Swale W****Hydrograph**

**719300 POST**

Type III 24-hr 2-yr Rainfall=2.95"

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**Summary for Pond 2P: Swale E**

Inflow Area = 19,560 sf, 58.54% Impervious, Inflow Depth > 1.00" for 2-yr event  
 Inflow = 0.56 cfs @ 12.09 hrs, Volume= 1,635 cf  
 Outflow = 0.09 cfs @ 12.62 hrs, Volume= 1,629 cf, Atten= 83%, Lag= 31.8 min  
 Discarded = 0.09 cfs @ 12.62 hrs, Volume= 1,629 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 338.65' @ 12.62 hrs Surf.Area= 1,686 sf Storage= 552 cf  
 Flood Elev= 341.00' Surf.Area= 4,761 sf Storage= 8,231 cf

Plug-Flow detention time= 54.6 min calculated for 1,624 cf (99% of inflow)  
 Center-of-Mass det. time= 53.1 min ( 864.6 - 811.5 )

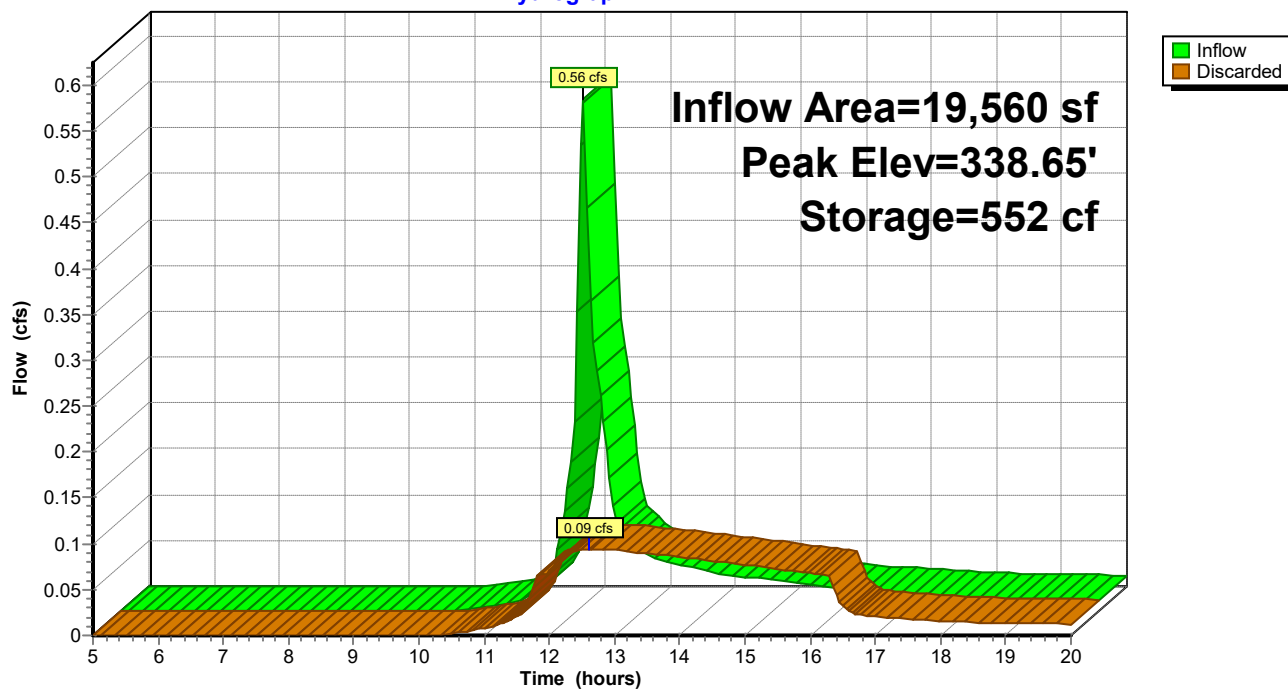
Volume	Invert	Avail.Storage	Storage Description
#1	338.25'	8,231 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
338.25	1,128	366.0	0	0	1,128
339.00	2,283	394.0	1,254	1,254	2,845
340.00	3,493	413.0	2,867	4,121	4,130
341.00	4,761	432.0	4,111	8,231	5,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.25'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.09 cfs @ 12.62 hrs HW=338.64' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.09 cfs)

**Pond 2P: Swale E****Hydrograph**

**Summary for Pond 3P: Offsite Runoff**

Inflow Area = 44,000 sf, 48.78% Impervious, Inflow Depth = 0.00" for 2-yr event

Routing by Stor-Ind method

**719300 POST***Type III 24-hr 10-yr Rainfall=4.25"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment PWS-1: W**

Runoff Area=24,440 sf 40.97% Impervious Runoff Depth>1.31"  
Flow Length=242' Tc=5.4 min CN=69 Runoff=0.90 cfs 2,665 cf

**Subcatchment PWS-2: E**

Runoff Area=19,560 sf 58.54% Impervious Runoff Depth>1.94"  
Flow Length=303' Tc=5.3 min CN=78 Runoff=1.09 cfs 3,159 cf

**Pond 1P: Swale W**

Peak Elev=338.45' Storage=718 cf Inflow=0.90 cfs 2,665 cf  
Outflow=0.21 cfs 2,655 cf

**Pond 2P: Swale E**

Peak Elev=339.02' Storage=1,298 cf Inflow=1.09 cfs 3,159 cf  
Outflow=0.13 cfs 3,148 cf

**Pond 3P: Offsite Runoff**

**Total Runoff Area = 44,000 sf Runoff Volume = 5,824 cf Average Runoff Depth = 1.59"**  
**51.22% Pervious = 22,538 sf 48.78% Impervious = 21,462 sf**

**Summary for Subcatchment PWS-1: W**

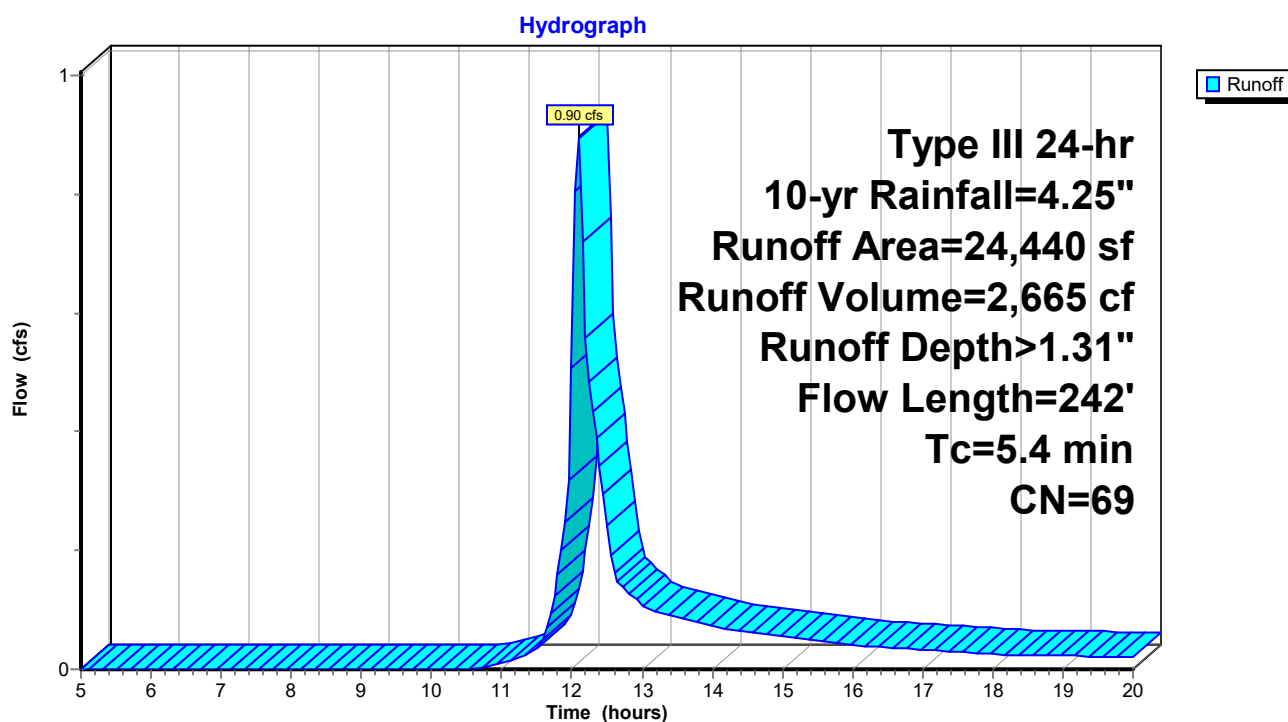
Runoff = 0.90 cfs @ 12.09 hrs, Volume= 2,665 cf, Depth> 1.31"  
 Routed to Pond 1P : Swale W

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
14,428	49	50-75% Grass cover, Fair, HSG A
4,012	98	Unconnected pavement, HSG A
6,000	98	Unconnected roofs, HSG A
24,440	69	Weighted Average
14,428		59.03% Pervious Area
10,012		40.97% Impervious Area
10,012		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	21	0.0150	0.86		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.95"
2.0	29	0.1044	0.25		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
3.0	192	0.0050	1.06		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
5.4	242	Total			

**Subcatchment PWS-1: W**

**Summary for Subcatchment PWS-2: E**

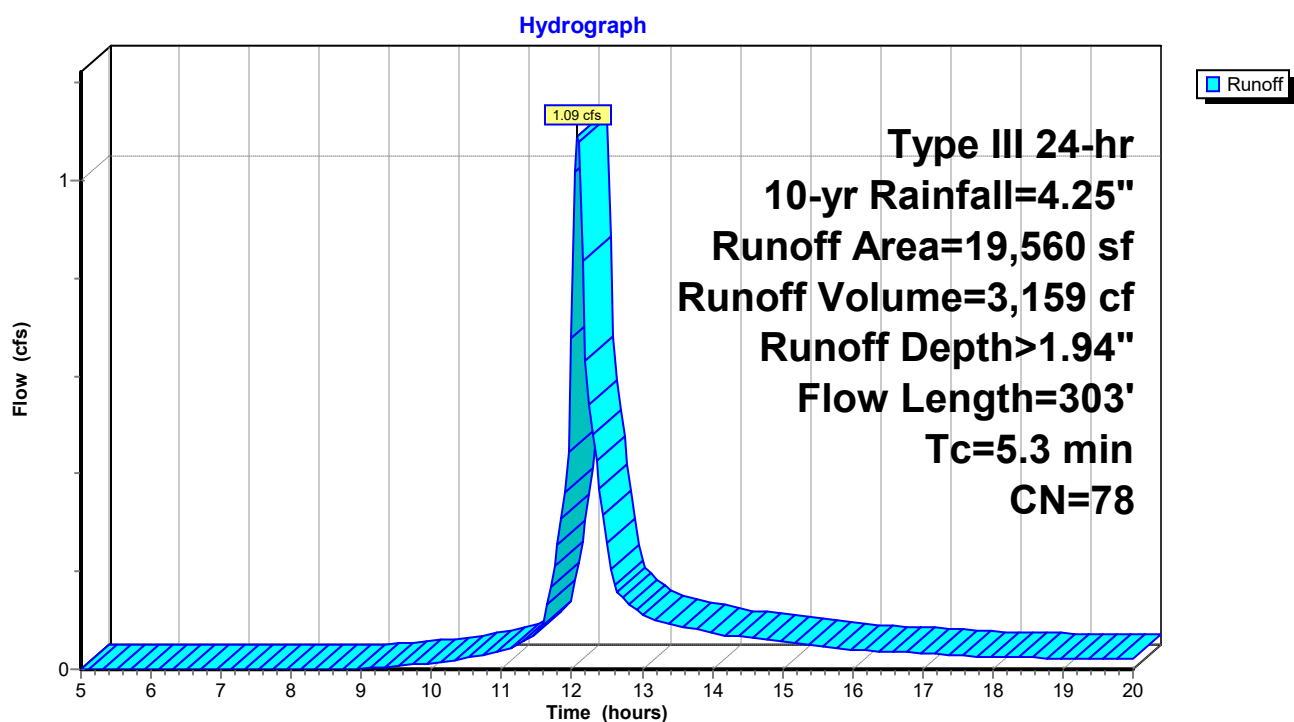
Runoff = 1.09 cfs @ 12.08 hrs, Volume= 3,159 cf, Depth> 1.94"  
 Routed to Pond 2P : Swale E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 10-yr Rainfall=4.25"

Area (sf)	CN	Description
6,000	98	Unconnected roofs, HSG A
8,110	49	50-75% Grass cover, Fair, HSG A
5,450	98	Unconnected pavement, HSG A
19,560	78	Weighted Average
8,110		41.46% Pervious Area
11,450		58.54% Impervious Area
11,450		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	38	0.0150	0.97		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.95"
2.7	12	0.0083	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
1.9	253	0.0220	2.22		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
5.3	303	Total			

**Subcatchment PWS-2: E**



**Summary for Pond 1P: Swale W**

Inflow Area = 24,440 sf, 40.97% Impervious, Inflow Depth > 1.31" for 10-yr event  
 Inflow = 0.90 cfs @ 12.09 hrs, Volume= 2,665 cf  
 Outflow = 0.21 cfs @ 12.53 hrs, Volume= 2,655 cf, Atten= 76%, Lag= 26.4 min  
 Discarded = 0.21 cfs @ 12.53 hrs, Volume= 2,655 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 338.45' @ 12.53 hrs Surf.Area= 3,805 sf Storage= 718 cf  
 Flood Elev= 341.00' Surf.Area= 7,121 sf Storage= 9,262 cf

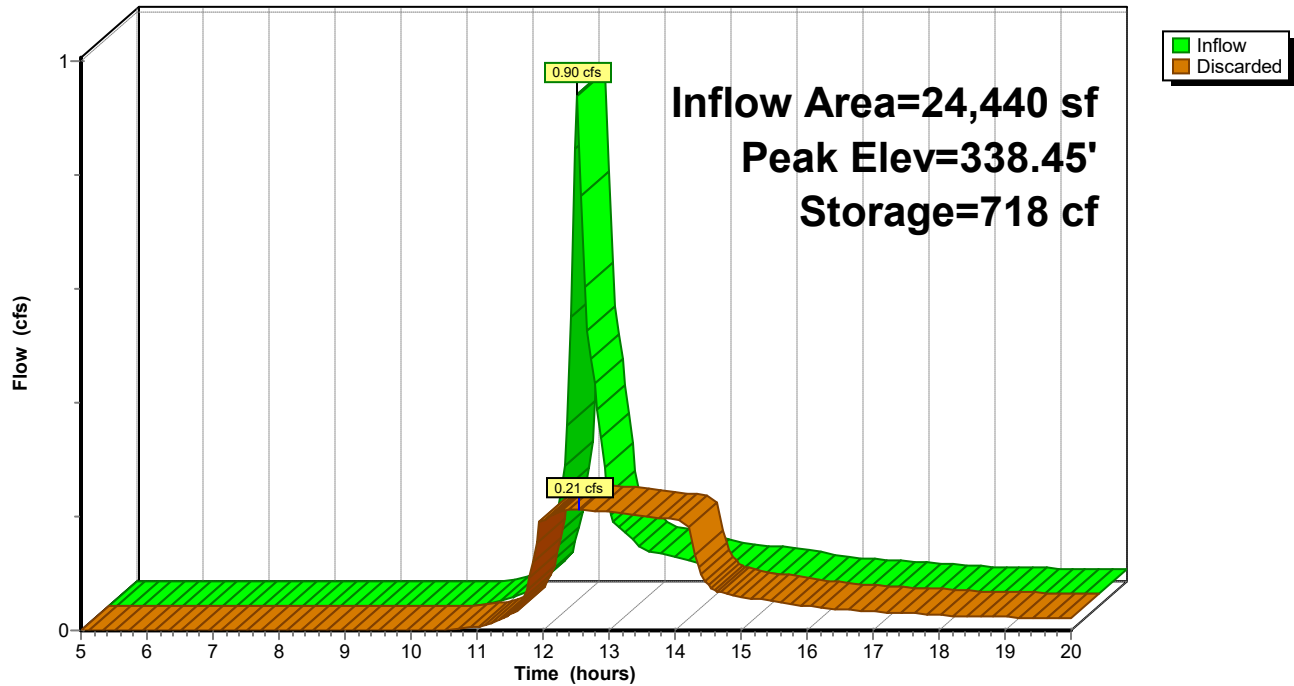
Plug-Flow detention time= 26.3 min calculated for 2,646 cf (99% of inflow)  
 Center-of-Mass det. time= 24.8 min ( 840.9 - 816.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	338.25'	9,262 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
338.25	3,371	560.0	0	0	3,371
339.00	5,129	602.0	3,165	3,165	7,279
340.00	7,121	666.0	6,098	9,262	13,768

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.25'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.21 cfs @ 12.53 hrs HW=338.45' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.21 cfs)

**Pond 1P: Swale W****Hydrograph**

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Type III 24-hr 10-yr Rainfall=4.25"

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**Summary for Pond 2P: Swale E**

Inflow Area = 19,560 sf, 58.54% Impervious, Inflow Depth > 1.94" for 10-yr event  
 Inflow = 1.09 cfs @ 12.08 hrs, Volume= 3,159 cf  
 Outflow = 0.13 cfs @ 12.87 hrs, Volume= 3,148 cf, Atten= 88%, Lag= 47.3 min  
 Discarded = 0.13 cfs @ 12.87 hrs, Volume= 3,148 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 339.02' @ 12.87 hrs Surf.Area= 2,304 sf Storage= 1,298 cf  
 Flood Elev= 341.00' Surf.Area= 4,761 sf Storage= 8,231 cf

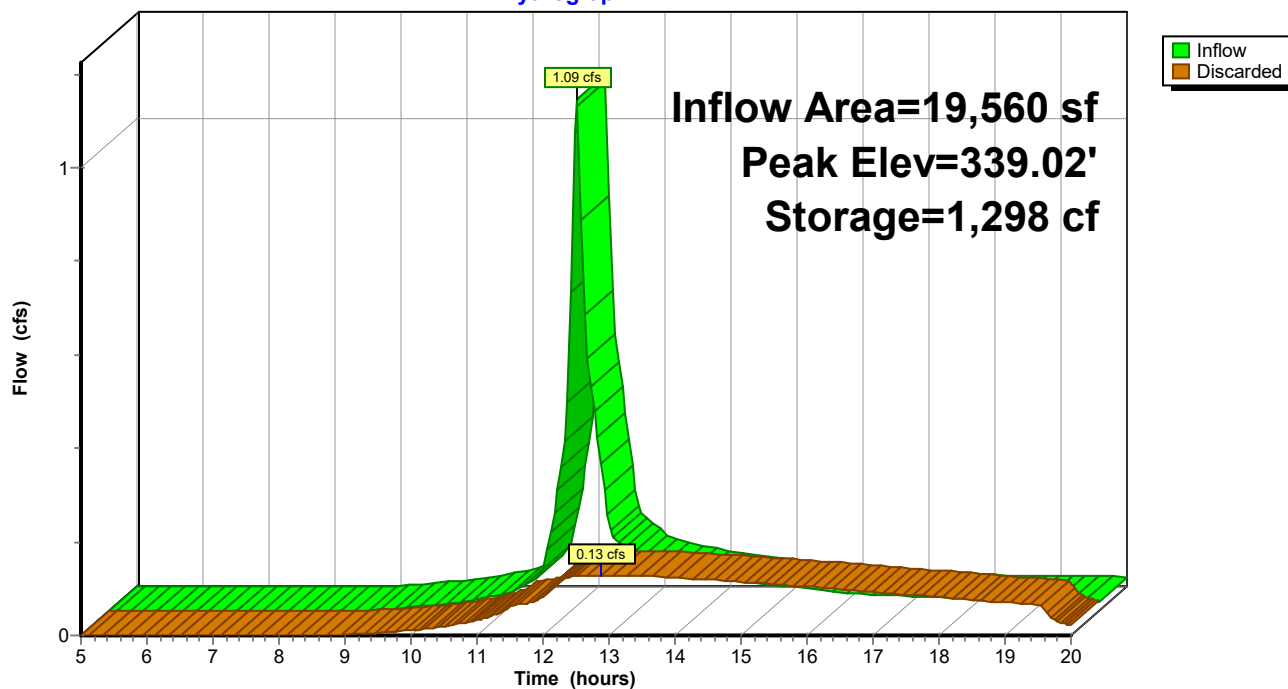
Plug-Flow detention time= 108.4 min calculated for 3,148 cf (100% of inflow)  
 Center-of-Mass det. time= 107.0 min ( 903.8 - 796.8 )

Volume	Invert	Avail.Storage	Storage Description
#1	338.25'	8,231 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
338.25	1,128	366.0	0	0	1,128
339.00	2,283	394.0	1,254	1,254	2,845
340.00	3,493	413.0	2,867	4,121	4,130
341.00	4,761	432.0	4,111	8,231	5,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.25'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.13 cfs @ 12.87 hrs HW=339.02' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.13 cfs)

**Pond 2P: Swale E****Hydrograph**

### **Summary for Pond 3P: Offsite Runoff**

Inflow Area = 44,000 sf, 48.78% Impervious, Inflow Depth = 0.00" for 10-yr event

Routing by Stor-Ind method

**719300 POST***Type III 24-hr 25-yr Rainfall=5.23"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment PWS-1: W**

Runoff Area=24,440 sf 40.97% Impervious Runoff Depth>1.96"  
Flow Length=242' Tc=5.4 min CN=69 Runoff=1.37 cfs 3,988 cf

**Subcatchment PWS-2: E**

Runoff Area=19,560 sf 58.54% Impervious Runoff Depth>2.71"  
Flow Length=303' Tc=5.3 min CN=78 Runoff=1.52 cfs 4,422 cf

**Pond 1P: Swale W**

Peak Elev=338.60' Storage=1,323 cf Inflow=1.37 cfs 3,988 cf  
Outflow=0.23 cfs 3,974 cf

**Pond 2P: Swale E**

Peak Elev=339.30' Storage=1,980 cf Inflow=1.52 cfs 4,422 cf  
Outflow=0.15 cfs 4,052 cf

**Pond 3P: Offsite Runoff**

**Total Runoff Area = 44,000 sf Runoff Volume = 8,410 cf Average Runoff Depth = 2.29"**  
**51.22% Pervious = 22,538 sf 48.78% Impervious = 21,462 sf**

**Summary for Subcatchment PWS-1: W**

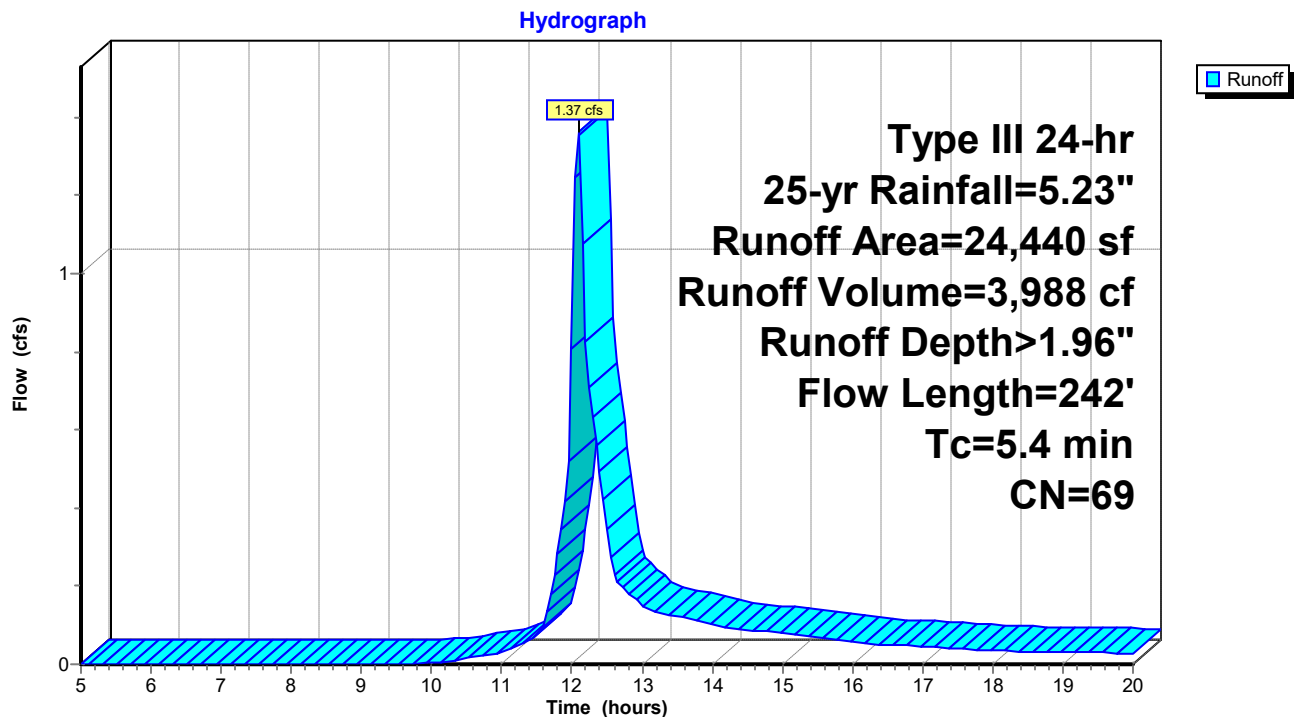
Runoff = 1.37 cfs @ 12.09 hrs, Volume= 3,988 cf, Depth> 1.96"  
 Routed to Pond 1P : Swale W

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 25-yr Rainfall=5.23"

Area (sf)	CN	Description
14,428	49	50-75% Grass cover, Fair, HSG A
4,012	98	Unconnected pavement, HSG A
6,000	98	Unconnected roofs, HSG A
24,440	69	Weighted Average
14,428		59.03% Pervious Area
10,012		40.97% Impervious Area
10,012		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	21	0.0150	0.86		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.95"
2.0	29	0.1044	0.25		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
3.0	192	0.0050	1.06		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
5.4	242	Total			

**Subcatchment PWS-1: W**

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Type III 24-hr 25-yr Rainfall=5.23"

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**Summary for Subcatchment PWS-2: E**

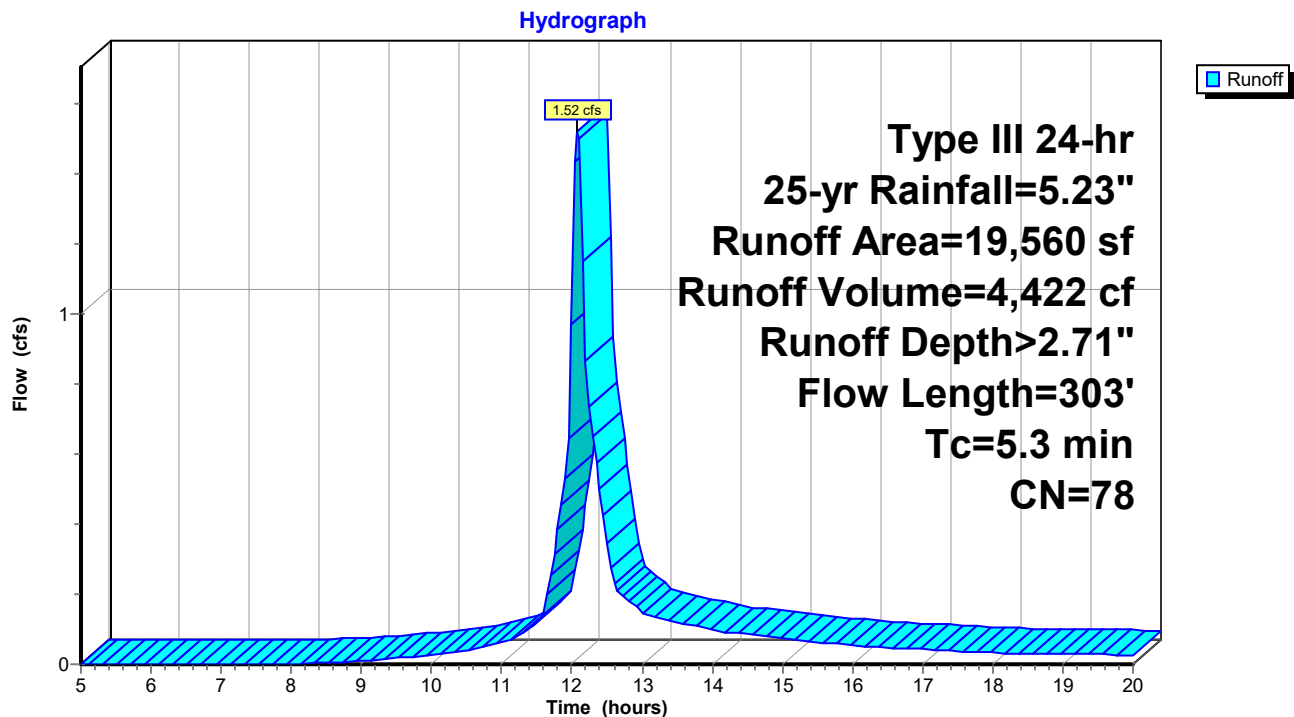
Runoff = 1.52 cfs @ 12.08 hrs, Volume= 4,422 cf, Depth> 2.71"  
Routed to Pond 2P : Swale E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 25-yr Rainfall=5.23"

Area (sf)	CN	Description
6,000	98	Unconnected roofs, HSG A
8,110	49	50-75% Grass cover, Fair, HSG A
5,450	98	Unconnected pavement, HSG A
19,560	78	Weighted Average
8,110		41.46% Pervious Area
11,450		58.54% Impervious Area
11,450		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	38	0.0150	0.97		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.95"
2.7	12	0.0083	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
1.9	253	0.0220	2.22		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
5.3	303	Total			

**Subcatchment PWS-2: E**



**Summary for Pond 1P: Swale W**

Inflow Area = 24,440 sf, 40.97% Impervious, Inflow Depth > 1.96" for 25-yr event  
 Inflow = 1.37 cfs @ 12.09 hrs, Volume= 3,988 cf  
 Outflow = 0.23 cfs @ 12.61 hrs, Volume= 3,974 cf, Atten= 83%, Lag= 31.1 min  
 Discarded = 0.23 cfs @ 12.61 hrs, Volume= 3,974 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 338.60' @ 12.61 hrs Surf.Area= 4,151 sf Storage= 1,323 cf  
 Flood Elev= 341.00' Surf.Area= 7,121 sf Storage= 9,262 cf

Plug-Flow detention time= 49.2 min calculated for 3,961 cf (99% of inflow)  
 Center-of-Mass det. time= 47.7 min ( 854.8 - 807.1 )

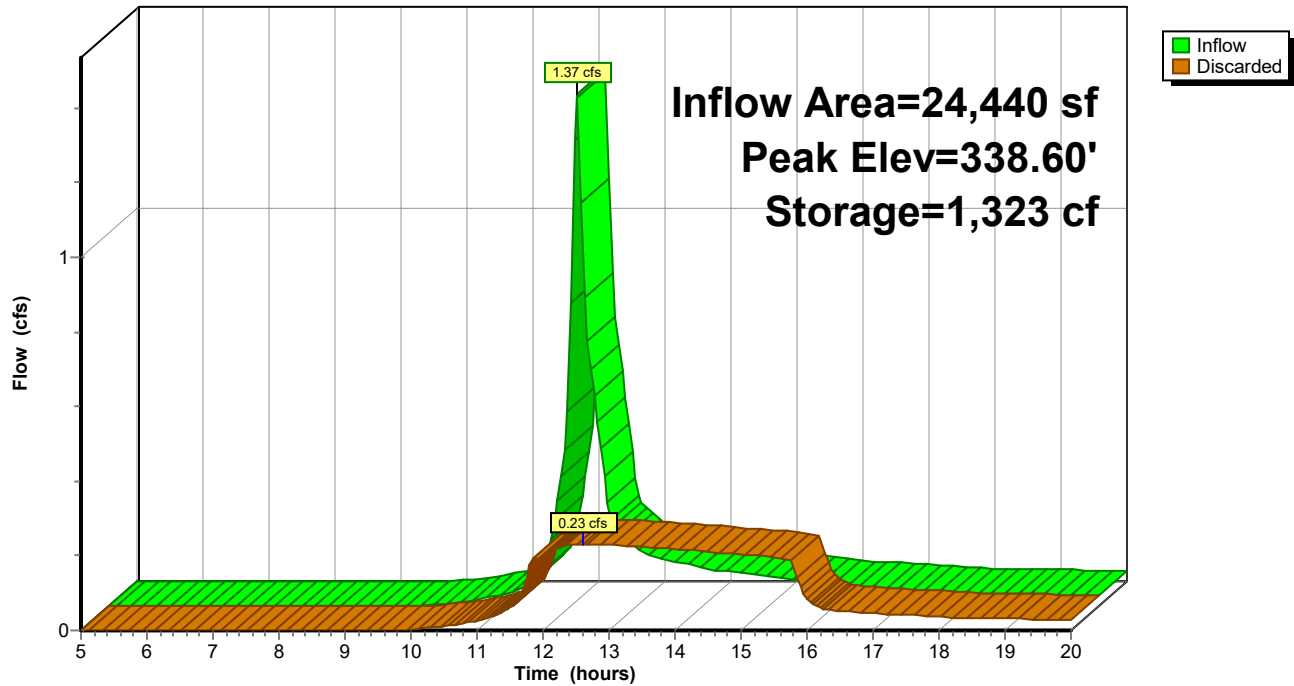
Volume	Invert	Avail.Storage	Storage Description
#1	338.25'	9,262 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
338.25	3,371	560.0	0	0	3,371
339.00	5,129	602.0	3,165	3,165	7,279
340.00	7,121	666.0	6,098	9,262	13,768

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.25'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.23 cfs @ 12.61 hrs HW=338.60' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.23 cfs)

**Pond 1P: Swale W****Hydrograph**

**719300 POST**

Type III 24-hr 25-yr Rainfall=5.23"

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**Summary for Pond 2P: Swale E**

Inflow Area = 19,560 sf, 58.54% Impervious, Inflow Depth > 2.71" for 25-yr event  
 Inflow = 1.52 cfs @ 12.08 hrs, Volume= 4,422 cf  
 Outflow = 0.15 cfs @ 13.03 hrs, Volume= 4,052 cf, Atten= 90%, Lag= 56.8 min  
 Discarded = 0.15 cfs @ 13.03 hrs, Volume= 4,052 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 339.30' @ 13.03 hrs Surf.Area= 2,615 sf Storage= 1,980 cf  
 Flood Elev= 341.00' Surf.Area= 4,761 sf Storage= 8,231 cf

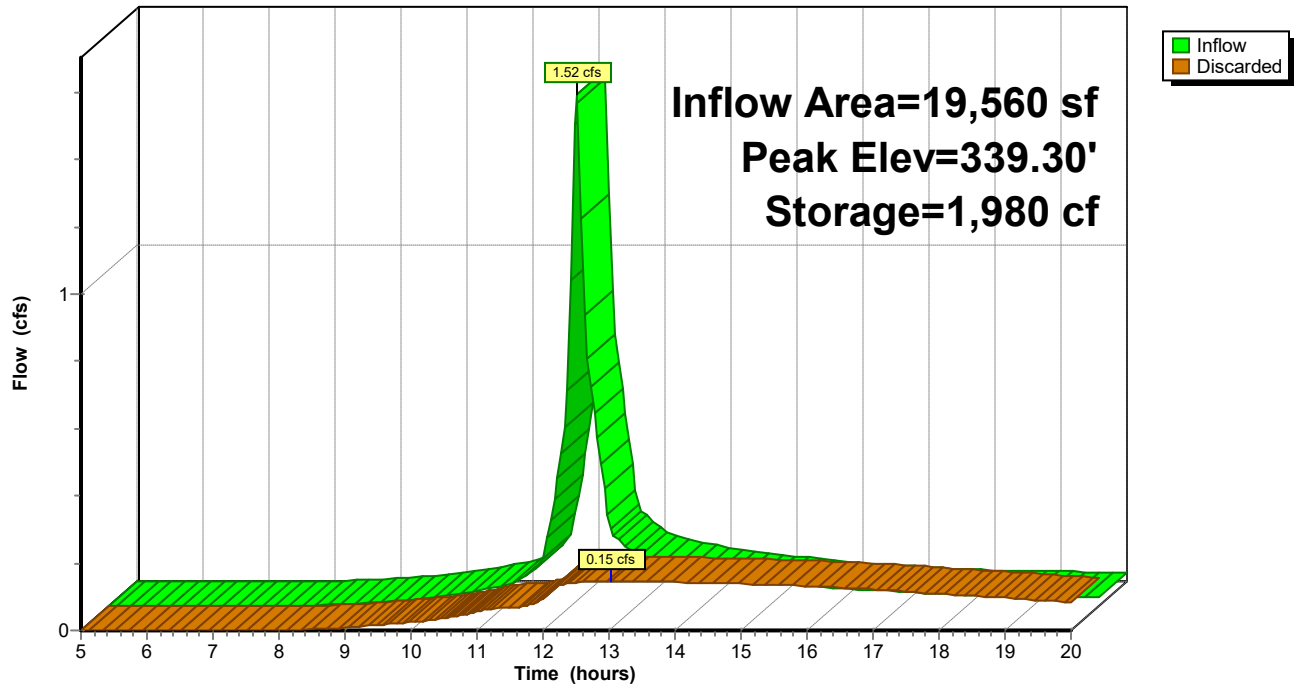
Plug-Flow detention time= 148.4 min calculated for 4,052 cf (92% of inflow)  
 Center-of-Mass det. time= 120.1 min ( 909.3 - 789.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	338.25'	8,231 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
338.25	1,128	366.0	0	0	1,128
339.00	2,283	394.0	1,254	1,254	2,845
340.00	3,493	413.0	2,867	4,121	4,130
341.00	4,761	432.0	4,111	8,231	5,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.25'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.15 cfs @ 13.03 hrs HW=339.30' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.15 cfs)

**Pond 2P: Swale E****Hydrograph**

### **Summary for Pond 3P: Offsite Runoff**

Inflow Area = 44,000 sf, 48.78% Impervious, Inflow Depth = 0.00" for 25-yr event

Routing by Stor-Ind method

**719300 POST***Type III 24-hr 100-yr Rainfall=7.18"*

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Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment PWS-1: W**

Runoff Area=24,440 sf 40.97% Impervious Runoff Depth>3.40"  
Flow Length=242' Tc=5.4 min CN=69 Runoff=2.39 cfs 6,933 cf

**Subcatchment PWS-2: E**

Runoff Area=19,560 sf 58.54% Impervious Runoff Depth>4.35"  
Flow Length=303' Tc=5.3 min CN=78 Runoff=2.41 cfs 7,096 cf

**Pond 1P: Swale W**

Peak Elev=338.93' Storage=2,790 cf Inflow=2.39 cfs 6,933 cf  
Outflow=0.28 cfs 6,912 cf

**Pond 2P: Swale E**

Peak Elev=339.83' Storage=3,537 cf Inflow=2.41 cfs 7,096 cf  
Outflow=0.18 cfs 5,533 cf

**Pond 3P: Offsite Runoff**

**Total Runoff Area = 44,000 sf Runoff Volume = 14,029 cf Average Runoff Depth = 3.83"**  
**51.22% Pervious = 22,538 sf 48.78% Impervious = 21,462 sf**

**Summary for Subcatchment PWS-1: W**

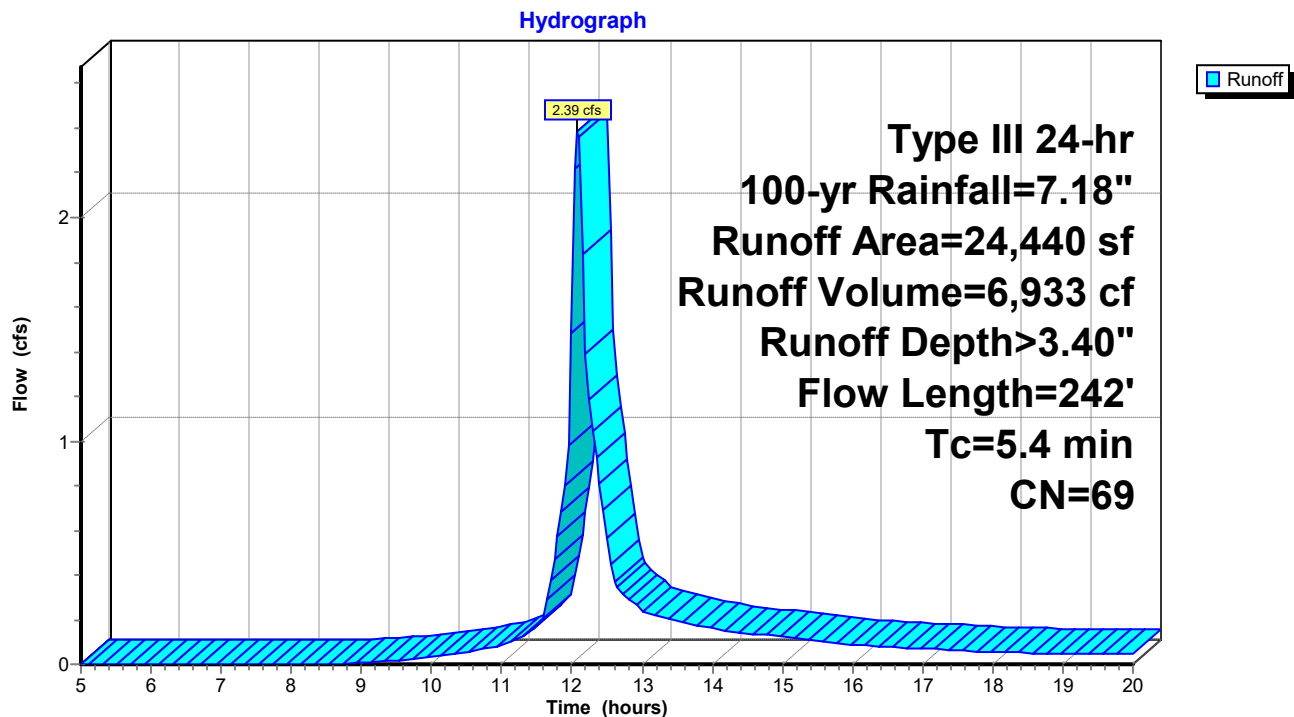
Runoff = 2.39 cfs @ 12.09 hrs, Volume= 6,933 cf, Depth> 3.40"  
 Routed to Pond 1P : Swale W

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-yr Rainfall=7.18"

Area (sf)	CN	Description
14,428	49	50-75% Grass cover, Fair, HSG A
4,012	98	Unconnected pavement, HSG A
6,000	98	Unconnected roofs, HSG A
24,440	69	Weighted Average
14,428		59.03% Pervious Area
10,012		40.97% Impervious Area
10,012		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	21	0.0150	0.86		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.95"
2.0	29	0.1044	0.25		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
3.0	192	0.0050	1.06		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
5.4	242	Total			

**Subcatchment PWS-1: W**

**Summary for Subcatchment PWS-2: E**

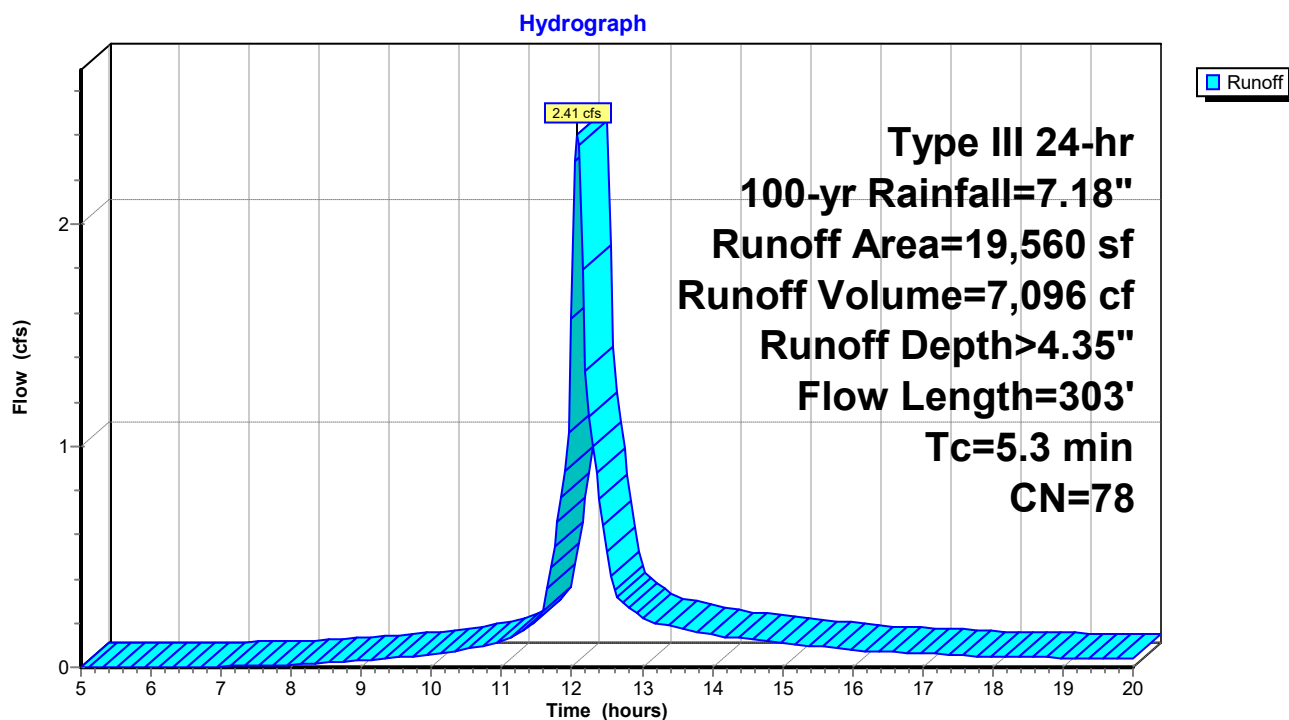
Runoff = 2.41 cfs @ 12.08 hrs, Volume= 7,096 cf, Depth> 4.35"  
 Routed to Pond 2P : Swale E

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Type III 24-hr 100-yr Rainfall=7.18"

Area (sf)	CN	Description
6,000	98	Unconnected roofs, HSG A
8,110	49	50-75% Grass cover, Fair, HSG A
5,450	98	Unconnected pavement, HSG A
19,560	78	Weighted Average
8,110		41.46% Pervious Area
11,450		58.54% Impervious Area
11,450		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.7	38	0.0150	0.97		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 2.95"
2.7	12	0.0083	0.08		<b>Sheet Flow,</b> Grass: Short n= 0.150 P2= 2.95"
1.9	253	0.0220	2.22		<b>Shallow Concentrated Flow,</b> Grassed Waterway Kv= 15.0 fps
5.3	303	Total			

**Subcatchment PWS-2: E**



**Summary for Pond 1P: Swale W**

Inflow Area = 24,440 sf, 40.97% Impervious, Inflow Depth > 3.40" for 100-yr event  
 Inflow = 2.39 cfs @ 12.09 hrs, Volume= 6,933 cf  
 Outflow = 0.28 cfs @ 12.88 hrs, Volume= 6,912 cf, Atten= 88%, Lag= 47.9 min  
 Discarded = 0.28 cfs @ 12.88 hrs, Volume= 6,912 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 338.93' @ 12.88 hrs Surf.Area= 4,938 sf Storage= 2,790 cf  
 Flood Elev= 341.00' Surf.Area= 7,121 sf Storage= 9,262 cf

Plug-Flow detention time= 100.9 min calculated for 6,889 cf (99% of inflow)  
 Center-of-Mass det. time= 99.4 min ( 894.1 - 794.7 )

Volume	Invert	Avail.Storage	Storage Description
#1	338.25'	9,262 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
338.25	3,371	560.0	0	0	3,371
339.00	5,129	602.0	3,165	3,165	7,279
340.00	7,121	666.0	6,098	9,262	13,768

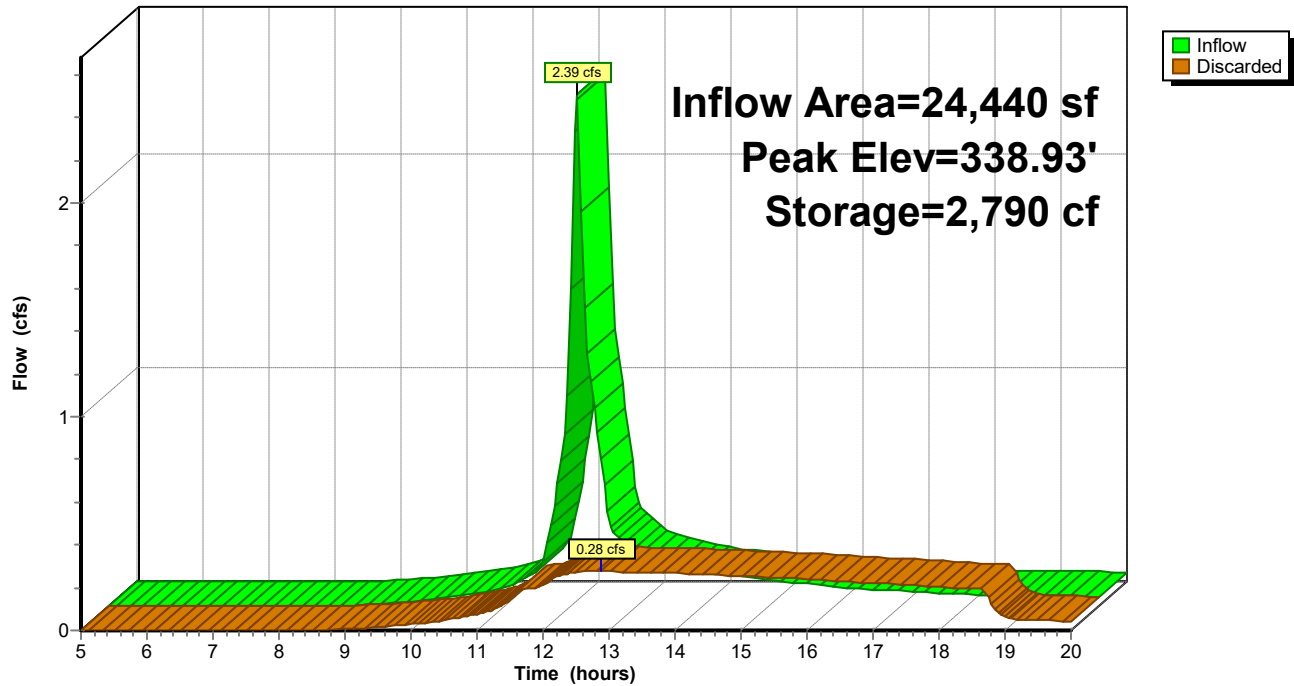
Device	Routing	Invert	Outlet Devices
#1	Discarded	338.25'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.28 cfs @ 12.88 hrs HW=338.93' (Free Discharge)

↑ **1=Exfiltration** (Exfiltration Controls 0.28 cfs)

**Pond 1P: Swale W**

Hydrograph



**Summary for Pond 2P: Swale E**

Inflow Area = 19,560 sf, 58.54% Impervious, Inflow Depth > 4.35" for 100-yr event  
 Inflow = 2.41 cfs @ 12.08 hrs, Volume= 7,096 cf  
 Outflow = 0.18 cfs @ 13.44 hrs, Volume= 5,533 cf, Atten= 92%, Lag= 81.5 min  
 Discarded = 0.18 cfs @ 13.44 hrs, Volume= 5,533 cf

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 339.83' @ 13.44 hrs Surf.Area= 3,266 sf Storage= 3,537 cf  
 Flood Elev= 341.00' Surf.Area= 4,761 sf Storage= 8,231 cf

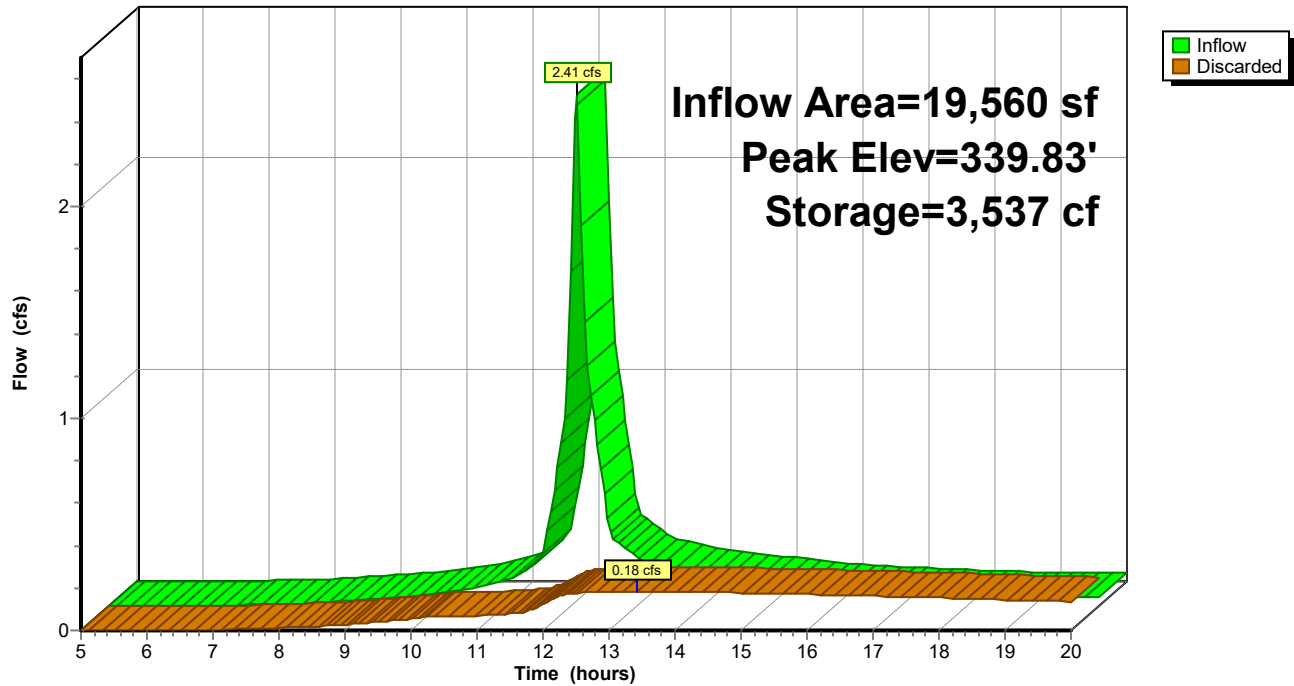
Plug-Flow detention time= 183.9 min calculated for 5,533 cf (78% of inflow)  
 Center-of-Mass det. time= 127.5 min ( 905.6 - 778.1 )

Volume	Invert	Avail.Storage	Storage Description
#1	338.25'	8,231 cf	<b>Custom Stage Data (Irregular)</b> Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
338.25	1,128	366.0	0	0	1,128
339.00	2,283	394.0	1,254	1,254	2,845
340.00	3,493	413.0	2,867	4,121	4,130
341.00	4,761	432.0	4,111	8,231	5,476

Device	Routing	Invert	Outlet Devices
#1	Discarded	338.25'	<b>2.410 in/hr Exfiltration over Surface area</b>

**Discarded OutFlow** Max=0.18 cfs @ 13.44 hrs HW=339.83' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.18 cfs)

**Pond 2P: Swale E****Hydrograph**

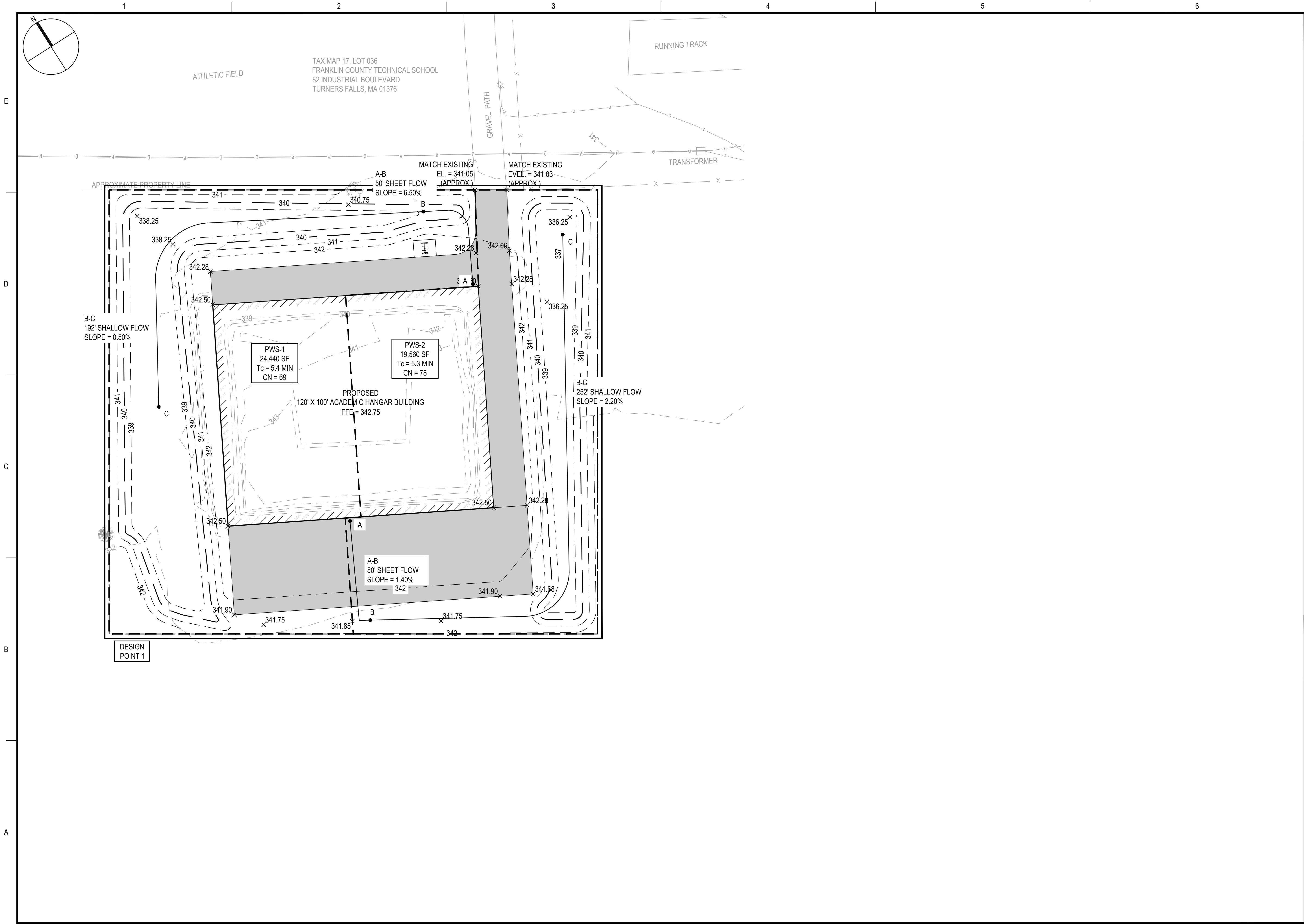
### **Summary for Pond 3P: Offsite Runoff**

Inflow Area = 44,000 sf, 48.78% Impervious, Inflow Depth = 0.00" for 100-yr event

Routing by Stor-Ind method



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**Gale Associates, Inc.**  
Engineers and Planners

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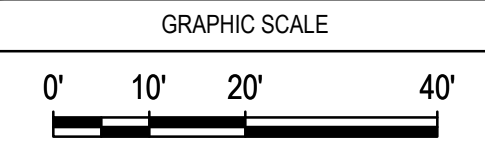
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PERMIT SET

NOT FOR CONSTRUCTION

PROJECT	ACADEMIC HANGAR TURNERS FALLS MUNICIPAL AIRPORT		
	TURNERS FALLS MUNICIPAL AIRPORT 1 AVENUE A TURNERS FALLS, MASSACHUSETTS 01376		
OWNER	TURNERS FALLS MUNICIPAL AIRPORT 1 AVENUE A TURNERS FALLS, MASSACHUSETTS 01376		

NO.	DATE	DESCRIPTION	BY
PROJECT NO.	719300		
CADD FILE	719300_POST		
DESIGNED BY	CRR/SMB		
DRAWN BY	CRR		
CHECKED BY	SMB		
DATE	11/10/23		
DRAWING SCALE	1" = 20'		



SHEET TITLE

POST  
DEVELOPMENTAL  
WATERSHED MAP

FIGURE NO.	
	11
	1 OF 1





## **APPENDIX D: OPERATION & MAINTENANCE MANUAL**





**OPERATION AND MAINTENANCE PLAN**

**TURNERS FALLS MUNICIPAL AIRPORT  
ACADEMIC HANGAR  
TURNERS FALLS MA, 01376**

**NOVEMBER 2023**

**Prepared for:**

Turners Falls Municipal Airport  
1 Avenue A  
Turners Falls, Massachusetts 01376

**Prepared by:**

Gale Associates, Inc.  
6 Bedford Farms Drive, Suite 101  
Bedford, NH 03110  
Gale JN 719300

**OPERATION AND MAINTENANCE PLAN**

**TURNERS FALLS MUNICIPAL AIRPORT  
ACADEMIC HANGAR**

**TABLE OF CONTENTS**

SECTION I	CONSTRUCTION ACTIVITIES
SECTION II	POST-DEVELOPMENT ACTIVITIES PART A – GENERAL PART B – BMP MANAGEMENT
SECTION III	LONG TERM POLLUTION PREVENTION PLAN (INSPECTION & MAINTENANCE LOGS INCLUDED)
SECTION IV	ILLCIT DISCHARGE STATEMENT

## **OPERATION & MAINTENANCE PLAN**

### **TURNERS FALLS MUNICIPAL AIRPORT ACADEMIC HANGAR**

#### **Basic Information**

Project Address: 10 Aviation Way, Turners Falls, MA 01376  
Owner: Turners Falls Municipal Airport  
Contact: Bryan Camden, Airport Manager (978) 305-2452  
Town: Montague, MA

#### **SECTION I: CONSTRUCTION ACTIVITIES**

1. Contact the Owner in writing at least seven (7) days prior to the start of construction.
2. Place the site sign (with contact numbers) prior to any work on site.
3. Install the erosion control BMPs as shown on the construction documents.
4. The silt fence and silt sock line shall be inspected on a weekly basis; any breaks in the line shall be repaired as soon as possible.
5. All erosion and sedimentation controls shall be in accordance with the DEP's Erosion and Sedimentation Control Guidelines and the USDA SCS Erosion and Sedimentation Control during site development.
6. All stockpile areas are to be protected by silt fence and silt socks, and shall be covered with a tarp to prevent moisture intrusion and dust concerns.
7. All disturbed areas shall be stabilized with mulch or seed immediately upon completion of construction activity. In no case, shall an area be left unstabilized for more than 14 days after the construction activity in that area has ceased.
8. All erosion control measures shall be inspected after any rainfall of 0.5" or greater.
9. All catch basins are to be ringed with silt socks and covered with a sediment filter until all up-gradient disturbed areas are stabilized.
10. All outlet orifices are to be ringed with silt socks until the detention structure or infiltration area is stabilized.
11. All slopes greater than 3:1 shall be stabilized with an erosion control blanket.
12. The contractor shall keep additional silt fence and straw bales on site to mitigate any emergency condition.
13. All proposed drainage structures (catch basins, manholes, outlet control structures and detention systems) should be cleaned at the end of construction and at any time the sediment within the structures equals 12" deep.
14. The contractor shall only disturb the minimum area necessary.
15. All illicit discharges are prohibited.
16. The entire project area shall be stabilized with vegetation upon completion of construction and prior to the removal of the erosion control devices.

## **OPERATION & MAINTENANCE PLAN**

### **TURNERS FALLS MUNICIPAL AIRPORT ACADEMIC HANGAR**

#### **SECTION II: POST-DEVELOPMENT ACTIVITIES**

##### **PART A - GENERAL**

- It shall be the responsibility of municipal employees to implement the procedures outlined herein.
- Any problems found with the drainage system shall be repaired within one week of discovery or sooner.
- The Owner shall employ a qualified professional to perform frequent maintenance, as described herein.
- All maintenance personnel shall be trained annually on the operation and maintenance procedures. A training log shall be maintained for records to document the annual training of employees.
- Inspection logs are included with this O&M Plan. The qualified professional shall provide the Owner with maintenance logs after each inspection or corrective action. The Owner shall keep record of these logs for at least three (3) years and shall provide copies to the Town, if requested.
- In the event that an infiltration BMP (infiltration swales) fails to drain within 72-hours of a storm event, a qualified professional should be consulted to determine what corrective actions may be necessary.
- All illicit discharges are prohibited.

##### **PART B - BMP MANAGEMENT**

Each Best Management Practice shall be maintained per the below requirements:

##### **CONVEYANCE SWALES & OVERLAND FLOW**

- Inspect swales to make sure vegetation is adequate and there are no signs of rilling and gullyng. Perform inspection the first few months after construction and twice a year thereafter. Repair any rills or gullies and replace dead vegetation, as necessary.
- Mow, as necessary. Grass height shall not exceed six (6) inches.
- Remove sediment and debris manually, at least once a year.
- Reseed, as necessary. Use of road salt or other deicers during the winter will necessitate yearly reseeding in the spring.

## **OPERATION & MAINTENANCE PLAN**

### **TURNERS FALLS MUNICIPAL AIRPORT ACADEMIC HANGAR**

#### **SECTION III: LONG TERM POLLUTION PREVENTION PLAN**

##### **GOOD HOUSEKEEPING PRACTICES**

- Prevent or reduce pollutant runoff from the project development using landscaping maintenance, trash clean up, erosion control measures, and frequent site cleaning.

##### **STORING MATERIALS AND WASTE PRODUCTS**

- All materials stored on site shall be stored in a neat and orderly fashion, in their appropriate containers, and under a roof or other secure enclosure. Waste products should be placed in secure receptacles until they are emptied by a licensed solid waste management company.

##### **ROUTINE INSPECTIONS AND MAINTENANCE OF STORMWATER BMPS**

- Follow the guidelines outlined above.

##### **MAINTENANCE OF LAWNS, GARDENS, AND OTHER LANDSCAPED AREAS**

- The Owner will be responsible for these activities.

##### **PET WASTE MANAGEMENT**

- Pet waste shall be placed in secure receptacles until they are emptied by a licensed solid waste management company.

##### **PROPER MANAGEMENT OF DEICING CHEMICALS AND SNOW**

- Snow disposal shall be in accordance with the Department of Environmental Protection, Bureau of Resource Protection, Snow Disposal Guidelines, Guideline No. BRPG01-01. In general, snow will be plowed in accordance with standard operating procedures. Whenever possible, the use of environmentally friendly alternatives (e.g., calcium chloride and sand instead of salt for melting ice) will be considered.

**OPERATION & MAINTENANCE PLAN**

**TURNERS FALLS MUNICIPAL AIRPORT  
ACADEMIC HANGAR**

**INSPECTION & MAINTENANCE LOG**

Inspected By: \_\_\_\_\_

Date: \_\_\_\_\_.

Days Since Last Rainfall: \_\_\_\_\_

Amount of Last Rainfall: \_\_\_\_\_ Inches

BMP Being Inspected:

**INFILTRATION SWALES**

Standing Water Observed	YES	NO
Depth of Standing Water (inches)		Not Applicable
Sediment Observed	YES	NO
Depth of Sediment (inches)		Not Applicable

Corrective Actions Taken:

Other Remarks:



**TURNERS FALLS MUNICIPAL AIRPORT  
ACADEMIC HANGAR**

**SECTION IV: ILLICIT DISCHARGE STATEMENT**

Standard 10 of the Massachusetts Stormwater Regulations prohibits illicit discharges to stormwater management systems. The stormwater management system is the system for conveying, treating, and infiltrating stormwater on site, including stormwater best management practices and any pipes intended to transport stormwater to the ground water, a surface water, or a municipal separate storm sewer system.

Illicit discharges to the stormwater management system are discharges that are not entirely comprised of stormwater. Notwithstanding the foregoing, an illicit discharge does not include discharges from the following activities or facilities: firefighting, water line flushing, landscape irrigation, uncontaminated ground water, potable water sources, foundation drains, air conditioning condensation, footing drains, individual resident car washing, flows from riparian habitats and wetlands, dechlorinated water from swimming pools, water used for street washing, and water used to clean residential buildings without detergents.

I, \_\_\_\_\_ (print name), certify that I have conducted a proper site investigation and verify that to the best of my knowledge there are no illicit discharges located at the TURNERS FALLS MUNICIPAL AIRPORT ACADEMIC HANGAR.

Signature\_\_\_\_\_

Date\_\_\_\_\_